for . . .

engineers and contractors controlling the design, specification, installation and maintenance of heating, ventilating and air conditioning.

HEATING AND VENTILATING

The Air Conditioning Monthly

PUBLISHER

THE INDUSTRIAL PRESS

President
ROBERT B. LUCHARS

Vice-President and Treasurer
EDGAR A. BECKER

Secretary
ERIK OBERG

EDITORIAL STAFF

Editor
CLIFFORD STROCK

Associate Editor
JOSEPH F. KERN, JR.

PUBLISHING INFORMATION

HEATING & VENTILATING is published monthly by the Industrial Press at 148 Lafayette Street, New York, N. Y. Western office, 228 North La Salle Street, Chicago, Ill. Yearly subscription in the United States, Spain, South America, Mexico, and Canada, $2.00; in all other countries, $3.00. Single copies 30 cents.

ADVERTISING REPRESENTATIVES

Eastern Representative
ALGWYNNE COLLINS
148 Lafayette Street
New York, N. Y.

Western Representative
GEORGE G. TURNER
228 North La Salle Street
Chicago, Ill.

Copyright, 1942, by the Industrial Press

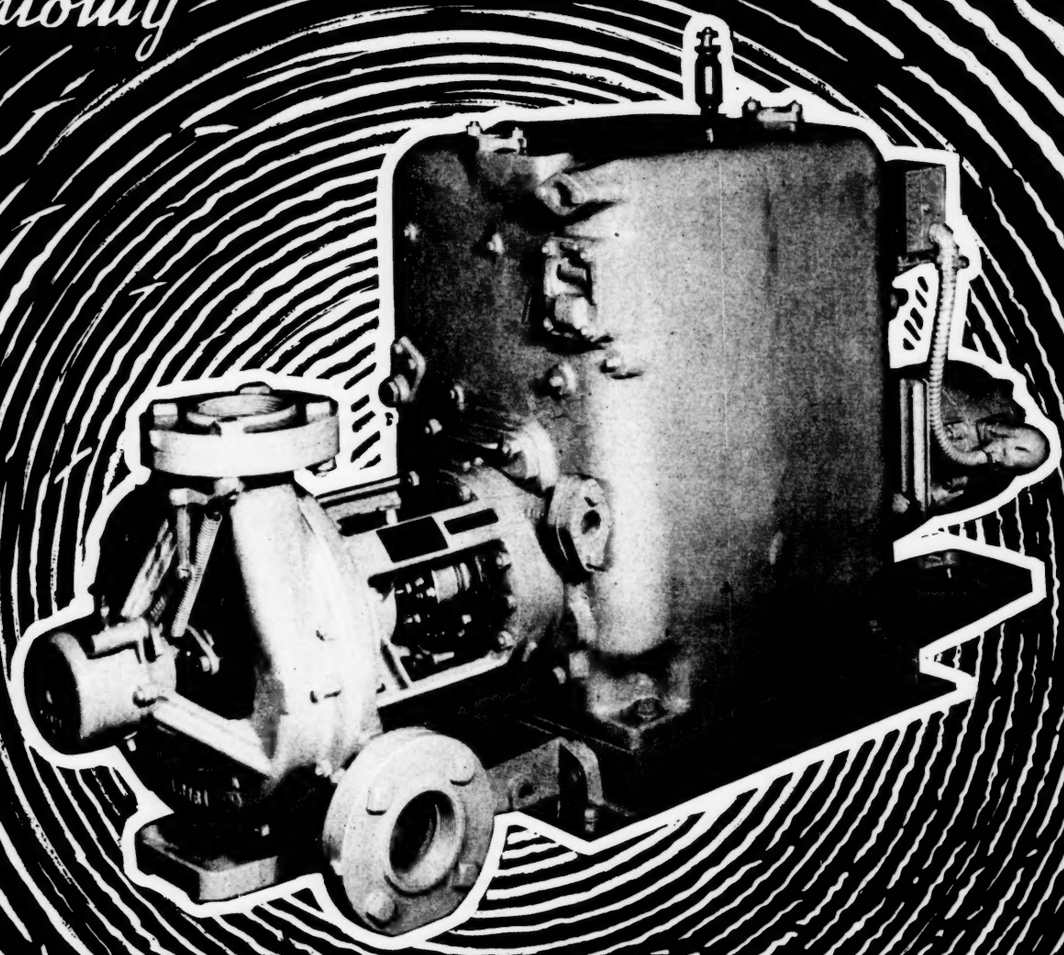
CONTENTS FOR APRIL, 1942

VOLUME 39 NUMBER 4

Cooling a Five Room House	19
Oil Burner Heats an Airplane Motor	21
Humidity as a Health Factor in Air Conditioning	22
Harvard Air Conditions Rare Book Library	24
Pointers on Valve Installation and Maintenance	25
Burning Low Grade Coals	27
Washington News	28
Heating a Mountain-Top Radio Station	32
Simple Test for Oil in Boiled Water	32
Theory vs Practice—Reducing Fuel Consumption	33
To Determine Relative Humidity Quickly	34
Reference Section 4	
Industrial Exhaust Ventilation	35
Applications	54
Abstracts	59
News of the Month	61
Reference Data 219 and 220	66
New Equipment	68
Degree Days for February, 1942	74
Personals and Personnel	76
With the Manufacturers	77
New Trade Literature	77
What Readers Say	79
Coming Events	80
H & V's Photos	80

MEMBER
Audit Bureau of Circulation
Associated Business Papers

Centralized Heating Economy



A RETURN LINE VACUUM PUMP THAT CUTS HEATING COST.

This unusual pump needs no electric current, cutting out greatest item of pump operating expense.

More important, this pump insures absolutely uniform circulation in system. That means continuous steam economy.

Simple, compact, one moving element, no wearing parts, no internal lubrication. Bulletin No. 203 gives the facts. Your copy is waiting.

THE NASH ENGINEERING COMPANY
SOUTH NORWALK, CONNECTICUT, U. S. A.

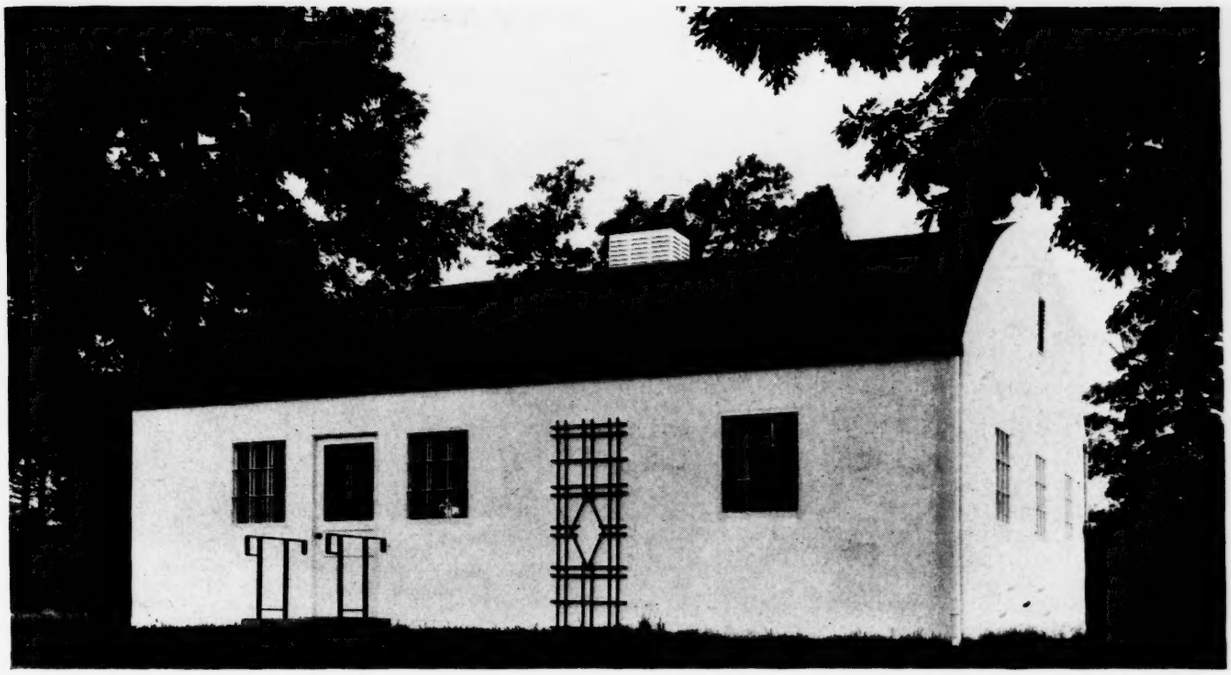


Fig. 1. Purdue house cooled by method explained by author.

COOLING A FIVE-ROOM HOUSE

described by Carl F. Boester† who has adapted, for Purdue Housing Research, a variation of the evaporative cooling method requiring only one-third horsepower in motor capacity.

EVER since the author read an article in the February, 1939, issue of HEATING AND VENTILATING, by A. S. Richardson, on the cooling of a copper mine having a refrigeration load of 550 tons *without* the employment of refrigeration, he has been greatly intrigued with the possibility of applying the fundamental principles outlined by Mr. Richardson to the cooling of a house, necessarily with some modifications of the idea, and with what equipment would be commercially available rather than with special equipment. So, during the summer of 1941, an installation of this same type was made in an experimental house on the Purdue University Housing Research Campus.

The principle outlined by Mr. Richardson was one providing for, by the process of evaporation, the cooling of water to a point approaching the dew-point temperature rather than to the wet-bulb temperature as most conventional cooling towers are designed to operate. His method involved the development of a special type of cooling tower for the purpose. A distinct advantage of his application is that wet-bulb and dry-bulb conditions generally prevail in the area of his experiment in such combination that there is a favorable dew-point prevailing for this purpose. While the conditions are not nearly so favorable in Lafayette, nevertheless, it was decided to try out the principle.

For the benefit of anyone interested, it is suggested that the article by Mr. Richardson referred to be reviewed, for it outlines why and how the seeming impossibility of cooling water by evaporation to an approach to dew-point temperature is achieved. Explaining it as simply as possible, this is a complete cooling cycle in which evaporation is used to cool the water, and part of this water is then used to lower the air wet-bulb temperature entering the cooling tower and before it goes into the cooling tower. It must be remembered that the wet-bulb temperature is indicative of the total heat content of the air. By extracting as much sensible heat as possible from the air as it passes through coils before entering the tower, such air is reduced in total heat, and thereby in wet-bulb temperature. The tower then cools the water to a temperature approaching the wet-bulb temperature of the air leaving the coils and entering the tower. This approaches the outdoor dew-point temperature.

To explain it rather technically, Mr. Richardson states in another article[1]: "As heat is abstracted from the air by the water at the heat absorber, it is

†Director, Housing Research, Purdue University, Lafayette, Ind.

[1]Engineering and Mining Journal, October, 1938.

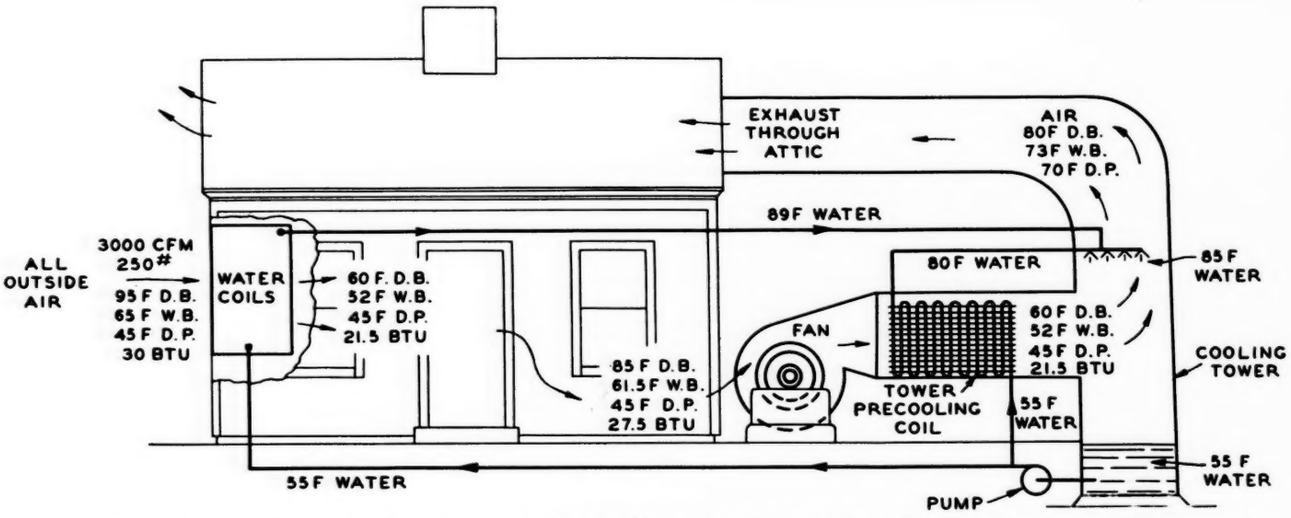

EXHAUST THROUGH ATTIC
AIR 80F D.B. 73F W.B. 70F D.P.
89F WATER
ALL OUTSIDE AIR
3000 CFM 250#
95 F D.B. 65 F W.B. 45 F D.P. 30 BTU
WATER COILS
60 F. D.B. 52 F W.B. 45 F D.P. 21.5 BTU
80F WATER
85 F WATER
FAN
60 F D.B. 52 F W.B. 45 F D.P. 21.5 BTU
COOLING TOWER
85 F D.B. 61.5 F W.B. 45 F D.P. 27.5 BTU
TOWER PRECOOLING COIL
55 F WATER
55 F WATER
55 F WATER
PUMP

Fig. 2. Typical example of method covered in article. Calculations for this example are as follows:

COOLING COIL: Heat removed from air = 250 (30 — 21.5) = 2125 Btu. Water circulated = $\frac{2125}{89-55}$ = 62.5 lb = 7½ gpm.

RECOOLER: Heat removed from air = 250 (27.5 — 21.5) = 1500 Btu. Water circulated = $\frac{1500}{80-55}$ = 60 lb = 7.2 gpm.

TOWER: Temperature of water = $\frac{(65 \times 89) + (60 \times 80)}{125} = \frac{10600}{125}$ = 85F.

Heat removed from water = 125 (85 — 55) = 3750 Btu.
Air entering tower = 60F D.B., 52F W.B., 45F D.P., 21.5 Btu.
Heat added to air = 3750 Btu.
Air leaving tower = 80F D.B., 73F W.B., 70F D.P., 36.5 Btu.

HOUSE LOAD: 250 (27.5 — 21.5) = 1500 Btu per min.

evident that it must be returned from water to air in the cooling tower. From this it would seem that no real advantage is gained. However, when the air is heated in direct contact with the water at the cooling tower, its water-vapor content is increased by the evaporation of some of the water. Thus the heat of the air, when raised through a given temperature range in this manner, is increased both by the change in sensible temperature and also by the latent heat of evaporation of the increased vapor content. In cooling air through the same temperature range by indirect heat exchange at temperatures above the dew point, no change in water-vapor content occurs. Thus the heat removed from the air by this indirect heat exchange is limited to that required to effect the lowering of the sensible temperature, and is considerably less than is absorbed by the air in direct contact with the water. The difference between heat indirectly absorbed from the air, and directly imparted to it with accompanying evaporation of water vapor, is then available to cool the water from the mine at a lower temperature range. The process is regenerative with dew-point temperature as the lower limit."

To make the explanation a little simpler, Fig. 2 is an illustration of a typical example; the caption shows the calculations for this example.

In the house that was cooled it was found quite desirable to use only outside air as the agent of convection. It was cooled by the water from the cooling tower, distributed into the various rooms of the house, exhausted into and through the cooling tower precooling coils, through the cooling tower, and finally exhausted out through the attic space of the house. An analysis of the various heat exchanges taking place was made as shown in Fig. 2. While Fig. 2 shows the cooling tower alongside the house, in the actual installation all the equipment was in the attic.

The summer of 1941 in Lafayette was, by and large, rather cool, and it was hard to get much data. However, there were several hot days in August. One period from August 9 through August 11 was quite hot, and Table 1 shows the wet-bulb and dry-bulb temperatures

TABLE 1. TEMPERATURE AND HUMIDITY DATA FOR PURDUE HOUSE, AUGUST 9-11, 1941

Item	August 9				August 10				August 11			
	6 A.M.	Noon	6 P.M.	Mid.	6 A.M.	Noon	6 P.M.	Mid.	6 A.M.	Noon	6 P.M.	Mid.
	Temperature, F											
Cooling water	73	80	79	67	65	72	76	76	72	84	82	77
Outdoor wet-bulb	71	80	79	65	62	74	80	74	71	84	84	75
Outdoor dry-bulb	74	86	85	72	66	86	94	77	73	95	98	78
Air leaving house	80	81	69	73	79	83	74	75	76	75	75	77
Air leaving house (effective temperature)	76	76	66	69	76	78	72	72	73	70	72	73
Attic dry-bulb	72	86	80	67	63	78	80	74	71	90	—	—
	Relative Humidity, %											
Air leaving house	70	62	60	55	73	67	82	74	72	55	76	68
Attic air	83	58	70	78	84	61	60	83	84	56	—	—

of the outdoor air, the temperature of the water in the sump of the cooling tower, and the dry-bulb of the air as it was exhausted from the various rooms of the house and at a point just where it entered the precooling tower. Also given is the temperature of the air being exhausted through the attic space. It is needless to say that the wet-bulb temperature of this air was also high. A hythergraph was used in getting the temperature of the air as it left the house, and this also reflected the relative humidity of the air. (This is given in percentages in Table 1.) It is only natural that the relative humidity should be high, since it was entirely a sensible-heat exchange as far as cooling of the residence proper is concerned. Nevertheless, at no time was the house uncomfortable to occupants. As a matter of fact, there was a distinct sensation of comfort inside as compared with that prevailing outside. Incidentally, all outside air brought in was filtered.

It will be noticed in Table 1 that the water in the cooling tower varied from a couple of degrees above outdoor wet-bulb temperature to as much as four degrees below prevailing outdoor wet-bulb temperatures. In each case, readings were made of outdoor wet-bulb temperatures and of the temperature of the water in the cooling tower at the same time. This variation, of course, can be substantially accounted for by changes in the cooling load of the house, such as variations in occupants and such factors as leaving doors and windows open, which would change the air volume circulated through the house. It is hoped that wet- and dry-bulb temperatures during the summer of 1942 will be considerably more favorable for a system of this type, and, if it is, more numerous readings will be taken of the various temperatures prevailing.

The only expenditure of power was the running of a one-third horsepower electric motor, which operated the fan and the pump circulating the water through the cooling coil and through the cooling tower.

The temperature of the air leaving the house was, as a rule, one or two degrees warmer than the air at a four-foot level in the house. The air was exhausted through a grille in the ceiling of the bathroom, where it entered the cooling tower. In this way it did a good job of providing adequate ventilation in the bathroom.

Everything considered, with the equipment that was available, the job seemed to be rather remarkable. It might well be noted that the effective temperature inside at all times, for all practical purposes, was within the limits of the comfort zone.

Coils that were used ahead of the cooling tower were of the very inexpensive type, and therefore large quantities of cooling surface could be employed for this purpose. The cooling tower consists of nothing more than a sheet metal container in which were placed several capillary cells, which are simply containers having spun glass fibres placed in them in such a way so as to afford the highest possible efficiency.

The fundamental principles involved in this method would certainly be applicable in the design of evaporative condensers for refrigeration purposes or to cooling towers that are used to cool condenser water.

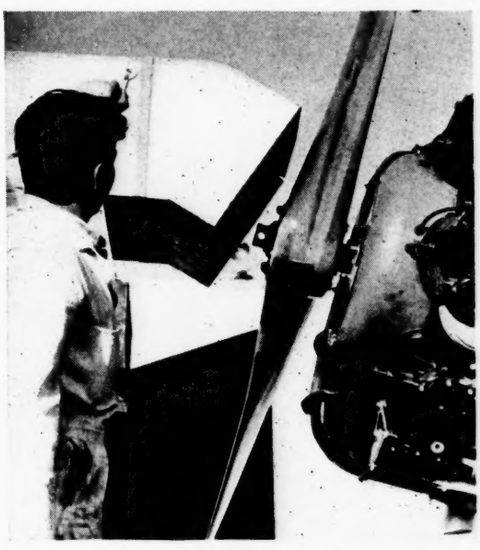
This project was simply an experiment to see how practicable such a method might be in the cooling of a house. In all probability Mr. Richardson has some patents pending and perhaps patents issued covering this general principle. If any reader should attempt to put this principle in general practice, it would probably be well to review the patent situation.

Oil Burner Heats Plane Motors

An oil burner is used on cold mornings at the Madison, Wis., municipal airport to warm up the motors of a hundred planes in unheated airplane hangars.

No. 60 oil is used in the planes to withstand the heat generated by an air-cooled engine. At freezing temperatures, this oil becomes practically solid. When a plane motor is started under these conditions, the wear and tear on the motor is high. Before the oil is warmed up enough to flow freely, rods or bearings may burn out of the motor, necessitating a major repair job.

Former practice at the municipal airport was to drain the oil from plane motors and store it at night in the furnace room of an airport building. This was laborious and also a fire hazard, since the oil was stored near a furnace.



Heated air developed by a Conco furnace burner unit is directed by this nozzle against the plane motor to warm up the motor oil on cold mornings.

Ernest Brandes, of Brandes Heating Co., Madison, working with the airport, solved the problem by providing a Conco oil-burner-furnace unit mounted on an automobile chassis for moving from plane to plane. The only change made in the standard unit was in the rate of firing. Power for the burner is obtained by an extension cord running into the hangar from the unit. To warm up a plane the unit is moved directly in front of the plane's motor. The extension on the plenum is then pulled out until it is directly against the engine, so as to direct a blast of warm air against the motor. Within a few minutes enough heat has been absorbed by the motor to warm the oil sufficient for normal flow.

Humidity as a Health Factor in Air Conditioning

By F. W. HUTCHINSON†

AS an oxygen-consuming, energy-rejecting animal, man lives submerged in four semi-independent, superimposed atmospheres:—oxygen, carbon dioxide, water vapor, and the inert constituents (as nitrogen and argon) of air. Dismissing the inert gases, any appreciable change in the vapor pressure of the other three items is likely to necessitate a re-adjustment of man's energy regulating mechanism. Similarly, and further complicating the situation, the normal vapor pressures of oxygen, carbon dioxide and water vapor in the lungs differ from the outside values and can be changed even when the ambient atmospheres remain constant. Thus, as Dill has pointed out, early morning deep-breathing exercises not only achieve the desired result of bringing "fresh air" into the lungs, but simultaneously reduce the normal internal vapor pressure of carbon dioxide and thereby lead to dizziness and to other physiologically deleterious effects.

In addition to the eight internal and external atmospheres listed above there is the ninth all-embracing, but less tangible, "sea" of energy in which man exists and with which he must—as an energy-rejecting, heat engine—remain in balance. The intent of the present paper is to indicate briefly the influence of changes in the internal and external vapor atmospheres on the energy balance and to review the medical literature as to the effect on health of atmospheric humidity.

Mechanisms of Body Heat Loss by Evaporation

Lung Evaporation — Under normal comfort conditions the average sedentary adult dissipates approximately 100 Btu per hour by evaporation; of this, slightly less than 50% represents an increase in the latent heat of air passing through the lungs. Experiment has shown that in the comfort range the temperature and relative humidity of discharged air is practically constant. It follows that the absolute humidity is likewise constant so that the moisture gain and, therefore, the heat dissipation by lung and throat evaporation must vary as an inverse function of the absolute humidity of the external atmosphere. However, a few calculations of the percent change in lung evaporation on the maximum range of likely external atmosphere will show that, for engineering purposes, this effect is negligible. Lung evaporation is therefore not a controllable *comfort* factor in air conditioning.

Skin Evaporation — Insensible — Evaporation from the skin cannot be evaluated as a continuous function. Within the limits of normal comfort air conditioning evaporation of this type is not limited by diffusion, but by the body's output of insensible perspiration. In this range the production of insensible perspiration—a filtration from subcutaneous vessels not associated with the sweat glands—is insufficient to maintain a film of moisture on the skin. In consequence, the vapor pressure (which is a function of absolute humidity) has little effect on rate of evaporation.

The body's production of insensible perspiration is believed to be a direct function of the skin temperature —for constant work rate—up to the point at which visible sweat breaks out; skin evaporation therefore varies with dry bulb temperature and radiation, but is independent of humidity. Humidity does, however, have an indirect effect due to changes in capillary pressure resulting from circulatory adjustment; with increase in humidity, lung evaporation decreases, necessitating a shift of the heat load to convection and inducing a corresponding circulatory change which increases the skin temperature and therefore increases the rate of insensible perspiration.

The quantitative relationship between skin temperature and evaporation has not yet been established in general form, but is indicated from scattered data which are now available. Phelps and Vold found that skin temperature varies approximately .15F for each degree change in air temperature—thus shifting about 3% of the convective loss to evaporative loss for each degree increase in air temperature. More recently, Dr. C.-E. A. Winslow reported that in the zone of insensible perspiration the varying of humidity is relatively unimportant as a means of attaining comfort since an increase of 20 — 25% in relative humidity is necessary to compensate for a 1F drop in air temperature.

Skin Evaporation—Evaporative Regulation—As the dry bulb temperature increases the body finds it increasingly difficult to dissipate adequate heat quantities by convection and radiation. Eventually, the emergency system—the sweat glands—go into action and increase the evaporation loss in such a way that a surprisingly exact balance is maintained between waste heat production and dissipation. The temperature range in which such emergency regulation is possible is characterized by a satisfaction of the energy balance at the expense of comfort.

The temperature boundaries of the evaporative zone and the time interval over which such control can be continuously maintained are subject to wide individual variation and depend on such diverse factors as rate of work, body weight, season, climate and individual idiosyncrasy. Dill has shown that the quantity of fluid discharged by the sweat glands and the concentration of salts in that fluid are both subject to wide variation. The unacclimated individual sweats a fluid of high concentration; in consequence, the concentration of

†Assistant Professor of Mechanical Engineering, University of California, Berkeley, Calif.

body fluid does not rapidly increase and thirst does not become acute. Under such conditions body weight decreases and sustained maintenance of evaporative regulation is not possible.

As acclimatization takes place the salt concentration in sweat decreases, concentration in body fluid tends to increase, and thirst acts to bring about a replenishment of the water loss; under these conditions evaporative regulation can be maintained for long periods, providing only that the individual restores the salt loss by ingesting salt tablets or adding salt to drinking water. For moderate work in air at 100F the moisture loss from sweating may be as high as two gallons per day and the accompanying salt loss can easily be 10 or more grams in 24 hours.

As the dry bulb temperature continues to increase the evaporative load necessarily becomes greater and a point is eventually reached at which thermal balance is no longer possible. Breakdown may occur for one of two reasons: (1) Sweating becomes so profuse that liquid runs freely from the body surface without evaporating; (2) The sweat glands become unable to maintain a discharge rate sufficient to keep the body surface covered with a liquid film. In either event evaporative regulation is no longer able to carry the required load, dissipation of all waste heat is not maintained, storage occurs in the tissues, body temperature rises and physiological damage may occur.

Depending upon the rate of work the average clothed subject becomes incapable of maintaining evaporative regulation when the dry bulb temperature exceeds from 85 to 115F. Beyond the critical point humidity has no direct effect since the diffusion is no longer the controlling process.

Humidity and Health

The relation of humidity to health is not well understood. Some observers believe that low humidities, by drying the mucous membranes of the nose, throat and lungs, lower the resistance of these organs to infection. The assertion has also been made that low humidities predispose to nervous and respiratory troubles.

Comprehensive tests of the effect of humidity on premature infants showed that relative humidities as low as 30% lead to serious consequences (for such infants) and indicated that 65% relative humidity is most desirable. According to Huntington there is reason to believe that high relative humidities are beneficial to adults also, but this conclusion is not in agreement with that of many investigators.

The New York Ventilation Commission found a high incidence of atrophic rhinitis among workers exposed to high temperatures and humidities; by comparison with a group exposed to high temperatures at moderate humidities they concluded that high humidity was the causative factor. A comparative health survey between cotton cloth workers (exposed to high temperature and humidity) and wool cloth workers (exposed only to high temperatures) showed a mortality from bronchitis 200% to 300% greater for the workers exposed to high humidities.

Other investigators have shown that the tuberculosis death rate is 29% greater for male cotton spinners than for the standard population and 160% greater for female workers. These data are not conclusive, however, because there may be many factors other than humidity which are responsible for the high mortality. If humidity is the cause then the excessively high mortality among women workers suggests that sex may be of vital importance in the determination of healthful conditions.

In direct opposition to the above evidence is a substantial body of material which indicates that the humidity does not affect health. British investigators could find no difference between the health of cotton cloth workers in humid and non-humid sheds. The Industrial Fatigue Board found a slight excess of sickness among operators in the non-humid sheds, but when they grouped sheds, not by the humidity depending upon the introduction of moisture, but by actual thermometer records, no significant difference in sickness incidence was detected—nor was any difference found between *very dry* and *very wet* groups.

The net effect of humidity on health cannot be evaluated until its indirect as well as its direct action has been determined. Thus, it is possible that the lowering of resistance to infection which is said to accompany certain humidity conditions may be of greater importance than is the systemic effect of the humidity itself.

On this subject, also, investigators are not in agreement. Dr. Knipfer studied the seasonal incidence of surgical skin infections and came to the conclusion that they are directly related to evaporation from the body surface; he states that with high humidities the increased perspiration permits formation of an acid envelope which protects the skin. In opposition to Dr. Knipfer's conclusions stand the earlier investigations of Norton and Novy, Cornbleet and Montgomery, Goff, and many others. Their work indicated that dry skin is least subject to infection because of its apparent power of self-sterilization. G. Arnold states that resistance to infection decreased when the skin is moist and that under such conditions bacteria remain viable for much longer periods. Fisher investigated 200 cases of boils among coal miners and concluded that the high wet bulb temperature under which they worked was, aside from individual susceptibility, the causative agent. He concluded that heat and moisture establish favorable conditions for the vitality of staphylococcus and suggested that the opening of sweat glands and hair follicles facilitates the entry of the organism.

A number of secondary influences of humidity on health are worthy of note. Recent European studies have shown that odor intensity is an inverse function of humidity. Since it has been demonstrated that odor, even when not perceptible to the persons in the contaminated space (because of odor fatigue), has an appreciable effect on appetite, it follows that humidity may be an important aggravating agent in improperly ventilated spaces.

The importance of low relative humidities in the treatment of pollen asthma has been definitely established. It is interesting to note that the simple cool-

ing of filtered air, by increasing relative humidity, may aggravate such asthma. Air conditioning systems which do not provide for the dehumidification of the cooled air may be less effective than a simple air filter.

Summary

In conclusion, the present state of knowledge concerning humidity and health is very unsatisfactory. There would seem to be little justification for the advocacy of humidity control as a health measure. On the other hand the possibility that unusual humidities may be decidedly unhealthful is sufficiently well founded to warrant the greatest hesitancy on the part of the engineer in using air conditioning methods which result in unusually high or low humidities even though they may be within the so-called comfort zone. Within the comfort zone, the most important influence seems to be the inverse relationship, pointed out by Bedford, which exists between that intangible quality called *freshness* and the humidity of indoor air.

Harvard Air Conditions Rare Book Library

Some of the rarest and most valuable books and manuscripts in the world, a group conservatively valued at a million dollars, are now safely housed in an air conditioned library at Harvard University. These are part of a collection of some 90,000 pieces, previously stored in the famous Treasure Room at the Widener Library, alongside which the new building has been erected. The structure, three stories above ground, and three below ground level, is the gift of Arthur Amory Houghton, Jr. of Corning, N. Y., rare book curator of the Library of Congress.

The building is of Georgian style architecture, brick and limestone, matching other important buildings in Harvard Yard. The thick walls are waterproofed and insulated with 1 in. of cork. Double-glazed windows and glass wool in the roof structure give additional insulation.

Included in the collection is the only book from the 5,000 volume library of John Harvard that was saved from the fire of 1765, which destroyed most of his collection and badly damaged Harvard Hall. About 400 volumes of the John Harvard library had been out on loan and so were not in the fire.

Also included in the collection are books with marginal notes used by Thomas Carlyle in writing his "Cromwell" and "Frederick the Great", which he bequeathed to Harvard; a Greek exercise book used by John Dryden; Shelley's original manuscript of "Ode to a Skylark"; an autograph from the poet Milton, with a quotation from his "Comus", and one from Horace; a page from Thackeray's "Roundabout Papers", and over 1200 rare and unique cookbooks.

Also to be seen are Bibles dating from 1483, some in manuscript, some in African and East Indian languages and one in ancient Hebrew and Greek; Robert Burns' manuscript of "Scots Wha Hae Wi' Wallace Bled", and a first edition of David Copperfield, inscribed by Dickens to his friend, Charles Eliot Norton; letters by Ben Franklin, Darwin, Beethoven, Victor Hugo, Napoleon; a complete file of the 635 *Spectator* Papers; the original manuscript of Hawthorne's "House of Seven Gables", and many other rare examples.

Donor of the library, Arthur Amory Houghton, Jr., is a graduate in the class of 1929, a vice president of the Shakespeare Association of America and a noted collector of John Keats manuscripts.

The air conditioning equipment includes an electrostatic air cleaner, spray chamber with misting nozzles, a preheating coil, direct expansion cooling coils, heating coils, odor absorbers and a 30-ton Freon-12 compressor. Automatic controls are of the pneumatic type. Well water at 55F supplies the pre-cooling coil.

Design calls for summer temperature of 78 to 80F maximum dry bulb, with 45% relative humidity, and an allowed variation of 5%.

There are two main air ducts, one for the three upper floors and one for the three below ground level. The lower duct has a booster heater. Branch ducts have volume control dampers with indicating and locking quadrants.

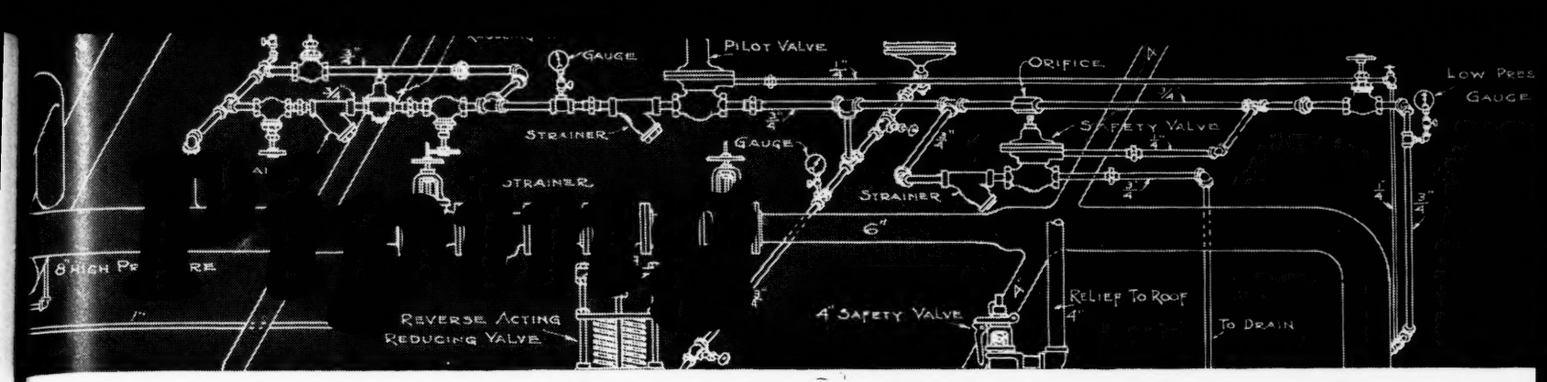
Supply and return air ducts are lined for a distance of 20 feet in the tunnels with a sound absorption material, as are most of the inlet and register boxes and ducts over the building. Ducts are equipped with fusible links and self-closing fire dampers.

Both adjustable wall grilles and circular ceiling outlets are provided. Return air is drawn through the registers located near the floor. Most rooms have thermostats controlling the pneumatic convector valves. A dewpoint thermostat on the exit side of the direct expansion cooling coil controls the compressor starter, pre-cooling water valves and the unloader device.

A direct humidistat controls the water valve on the humidifier sprays during winter and the pre-cooler water valve and compressor control in summer. Controls can be changed from winter to summer operation by a positive acting return air thermostat.

Return air, fire and by-pass dampers will be regulated in summer by a remote adjustable duct thermostat, which, in turn, is controlled by an outside air pilot thermostat. A static pressure regulator in the fan discharge duct controls the air volume damper.

Perry, Shaw & Hepburn of Boston were the architects and the George A. Fuller Company general contractors. Buerkel & Company, Boston, installed the air conditioning system.



Ten Important Pointers on Valve Installation and Maintenance

By FRED C. ERNST†

Conservation of critical materials is a matter of concern to every plant engineer both from the standpoint of common-sense, economy and that of patriotism. These ten rules for installing and maintaining valves to obtain maximum economy have been prepared for HEATING AND VENTILATING by Mr. Ernst who is a national authority on valves. When you read these rules you'll agree that it's just as easy to treat valves right as it is not.

A MOMENT of thoughtlessness or carelessness in installing a valve can completely frustrate all the years of experience, the care in designing, and the skill in manufacturing which enter into building that valve to make it efficient and long lasting.

There is nothing complicated about a correct valve installation. Only a few simple rules should be followed . . . *but they should be followed!*

1. Before Installing the Pipe: See that it is thoroughly cleaned internally, preferably with air or steam. Pipe usually accumulates a certain amount of scale in the rolling process and amasses a considerable quantity of dirt and other foreign matter in transit or storage. Unless this matter is removed before installation, it can cause damage to the seating surfaces of the valves when the line is put in service.

2. When Threading the Pipe: See that threads are of correct diameter and length. The correct diameter will insure proper fit with the valve threads; the correct length will eliminate danger of forcing the pipe against the valve diaphragm or seats. Too long threading can allow the pipe to press against these important parts, resulting in distortion or even destruction of the valve.

3. After Threading the Pipe: Get the threads perfectly clean; brush them vigorously to remove all chips. Then apply a suitable threading compound to the pipe threads only —not in the threaded ends of the valve or fitting. Use the compound sparingly. Then you will be certain that there will be no excess to be carried through onto the valve-seats. Failure to exercise this precaution is frequently the reason for failure of the valve to seat tightly when fluid is turned into the line.

4. When Installing the Pipe: Be sure that the line is properly supported. This is of great importance in all installations, and of supreme importance when smaller-sized bronze valves are to be installed. Proper (and sufficient) supports will prevent sagging of the line which would cause springing of the valve-bodies resulting in distortion that might cause serious leaks and could even completely destroy the efficiency of the valve.

5. Before Installing the Valves: See that the threaded ends of screwed-end valves and the ports of flanged-end valves are thoroughly cleaned. Then open the valves fully and flush them out, with water if possible; otherwise blow them out with air or steam. While this is being done, be sure that the ports are vertical, the spindle horizontal (that is, turn the valve on its side). Only in this way can you be sure of the complete removal of all foreign matter which might have accumulated during transit or otherwise. Once you do this thorough job of cleaning the inside of the body, close the valves tightly at once—before installing them in the line; thus you will prevent any new matter from lodging upon the seats.

6. When Installing the Valves: Wherever possible, see that all valves are installed with spindle straight up and down (vertically). This precaution will do more to insure tightness and increased life than any other recommendation that could be offered.

7. How Valves are to be Installed: *Globe and Angle Valves.* Fully 90% of all globe and angle valves are installed with the inlet pressure beneath the seat. Provided the valves are fitted with the correct disc for the intended service (renewable composition or other type) and assuming that they will be handled with ordinary care in operation, valves installed in this way usually function to complete satisfaction. However, when

†Chief Engineer, Jenkins Bros., New York.

operating conditions are extraordinary, or workmen do not turn the handwheels sufficiently to close the valves tightly, globe and angle valves can be reversed in the line (with pressure above the seat). This frequently overcomes most leak-troubles and reduces the need for attention and repairs. Another advantage of reversed-installation is found when abuse to a valve causes failure of the operating threads; the valve will close automatically in case of such failure (instead of blowing open) thus possibly averting serious injury to the operator and costly damage to the process involved.

Gate Valves. Unless they are of special construction, most gate valves can be installed with either face to the inlet side.

Lift Check Valves. These are made in three patterns: Horizontal, Angle and Vertical. The horizontal pattern must be installed horizontally and levelly so the internal parts rise and fall in a vertical plane. Flow should be beneath the seat for effective action and tight closure. The angle pattern must be installed with flow upwards—from beneath the seat. The vertical pattern is for use on vertical pipe lines only; it too must have the flow upwards—from beneath the seat.

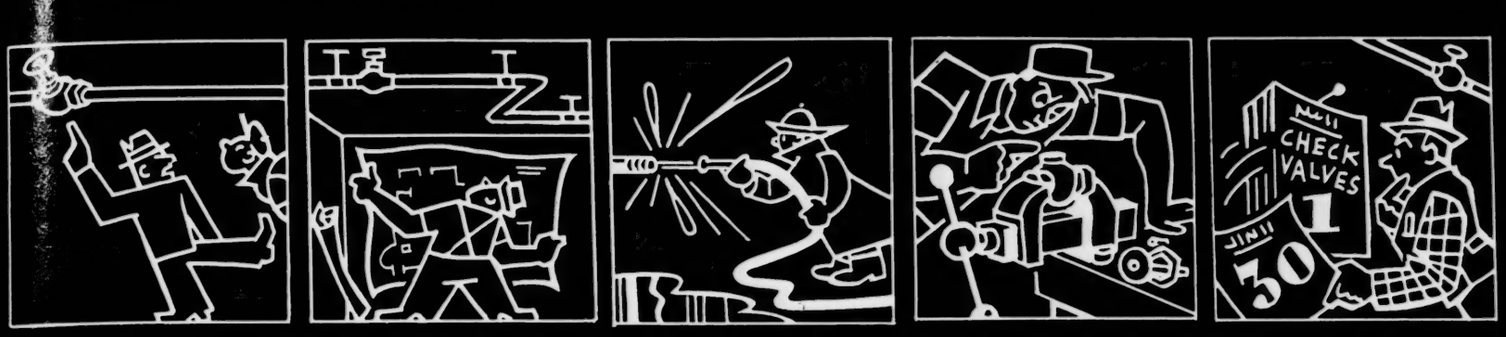
Swing Check Valves. Be very careful when installing these valves. It is so easy to put them in correctly, and just as easy to do the job wrong. Take a swing check valve in your hand. Notice that it has a plug on each side. (Regrinding types also have a plug at one end, above the hexagon or flange; but that is not important to the subject being discussed.) These two side plugs are your guide to correct installation! They hold in place the hanger pin which enables the disc to swing. The direction of this swing is upwards from the end of the valve opposite the plugs. Therefore, when installing a swing check valve, have the end with the plugs on its side towards the inlet flow so that the incoming fluid will open the valve and return flow close the valve. If a swing check valve is installed in reverse position it will stop the flow completely at this point. Some swing check valves have an arrow cast on the body to denote the direction of flow—the manner of installation; pay heed to it and you cannot go wrong.

Y or Blow-Off Valves. Although these valves are similar in internal construction to globe valves and therefore will function with flow above or below the seat, the ASME Boiler Code wisely stipulates that the flow should be beneath the seat. The reason for this is obvious: if the disc holder should become dislodged or the end of the spindle should shear off, the valve assumes the properties of a stop and check, opening with the inflow yet able to be closed by turning the handwheel. Should the flow be above the disc, the valve would close automatically and could not be opened without disassembling it; the line would be useless until repairs or replacement had occurred.

8. When Pipe-and-Valve Installation is Completed: Flush out the line with water or steam. When pressure and temperature have risen sufficiently to expand the metal, "follow" all bolts and nuts of pipe flanges and of valve-bonnet joints; also the nuts on packing boxes of the valves. If this is done promptly and properly, you will forestall a great number of the usual complaints about leaks and lack of tightness in a new installation. Failure to "follow" these bolts and nuts can create serious blow-outs at vulnerable and important points in the installation.

9. If Valves do not Hold Tight: Assuming that you have adopted and instituted all the precautions stated thus far—that your line is clean, the valves are clean and you have "followed" the bolts and nuts—you should find the valves closing tightly with only ordinary effort on the handwheel. But if this is not the case, then DO NOT apply extra leverage (or a wrench) to the wheel; you can ruin a valve easily this way. Instead, inspect the seating surfaces to locate the source of the trouble. Perhaps the wrong composition of disc has been used—one that is too hard or too soft for the fluid being handled; this condition can be rectified quickly and economically in renewable composition disc valves. If it is a regrind-renew valve, the wrong kind of metal may have been selected for disc and seat ring; parts can be secured to remedy this fault. Or perhaps there is a nick in the seat; a slight refacing or regrinding operation can usually correct this condition. In properly designed valves, these measures can be taken without removing the body from the line. So you see how important it is that you do not use brute strength on the valve (and probably ruin it) when a few minutes of thoughful investigation and minor attention can accomplish the desired effect much more thoroughly and far less expensively.

10. Valve Maintenance: The maintenance of valves can be reduced to an almost unbelievable low merely by periodic inspection. The frequency of these inspections depends upon specific service conditions and the incidence of operating the valve (every few minutes, a time or two a day, or once or twice a year; the more frequent the operation, the more frequent should be the inspection). If at any time there is evidence of seepage, redisc or regrind the valve immediately; otherwise the seep will become a leak, wire drawing of the



6. SPINDLES MUST BE VERTICAL | 7. CHECK VALVE INSTALLATION | 8. FLUSH OUT THE LINE | 9. CHECK VALVE ASSEMBLY | 10. INSPECT VALVES FREQUENTLY

seat will follow and the usefulness of the valve will be halted. Another, and more drastic, effect of leakage is the accumulation of condensate within the valve; if it is opened too quickly when in this condition, the resulting water hammer can be so excessive that it will destroy not only the valve and piping but the operator's life as well.

A second rule to follow in valve maintenance is this: *Never use a Stillson wrench on a valve!* Mr. Stillson invented that wrench for a specific purpose: to enable you to get a tight hold on a round object, such as a pipe. The ends of screwed valves are hexagons, as are the bonnet flats and the packing nut. When you need to tighten or loosen any of these parts, use a hex wrench or monkey wrench or an open-end wrench *every time;* you will not only get a firmer grip but you will also prevent *chewing away* of the part . . . another term for ruining the valve.

A third point is the proper procedure in regrinding valves. All regrinding and regrind-renew valves have (or should have) the union type of bonnet. Unscrew the union ring (using an end or a monkey wrench), remove the trimming, place a moderate amount of grinding compound on the disc or plug, insert a pin in the notch of the disc nut and the hole in the spindle, then reinsert the trimming. Then (and this is the important part) screw down the union ring as tightly as possible by hand, then back it off about 1½ turns—no more than that. If the valve is properly designed, you can then use the spindle as your grinding tool. (Do not overgrind; your purpose is to provide a new seating surface, not to wear down the disc.) Most important, by turning back the union ring only 1½ turns, you insure that the spindle remains truly vertical, that all parts are concentric—that you do not cock the disc or plug. If this is cocked, the resultant seating surfaces would not be perfectly uniform or true. When the grinding operation is completed, unscrew the union ring, remove the trimming, thoroughly clean every trace of grinding compound from both disc and seat—and you are ready to reassemble the valve.

Before you do, however, remove any scale from inside the bonnet and body, especially around the joints and the threads. Then oil those threads before putting the valve back together; the next removal will be made much easier if you do this every time you disassemble a valve.

These are by no means all the precautions to take when installing and maintaining valves. Your own experience will lengthen the list. Or consultation by mail with the engineering department of a reputable valve manufacturer will enable you to secure, without obligation, information on specific problems that may arise in the course of your work.

Burning Low Grade Coals

Experiments have been conducted in North Dakota on the burning of lignite coal under boilers. A 400 hp Stirling boiler was employed and it was equipped with multiple retort underfeed stokers which were considered best for the purpose.

In the experiments they found that by using a coking bituminous coal and mixing one and one-half times as much lignite with it steam could be generated more economically. In fact, 12% was saved by so doing.

There has been a marked tendency in nearly all industries during recent years to make use of the lower grade and cheaper fuels. Low grade bituminous coal and cheap lignite are being looked upon more favorably than ever before. High grade bituminous coal is entirely too expensive.

One of the objections to low grade coal is that it is harder to burn. Greater skill is required in firing it. To overcome this, underfeed stokers have come into prominence and recently these low grade coals are being pulverized. Pulverization is a very effective solution and the writer is of the opinion that we will do a great deal of it in coming years.

Lignite coal is very high in moisture and for that reason after being thrown upon the grate it disintegrates quickly and has a tendency to clog. Hence, large grate areas are necessary. It is obviously unwise to change over from the burning of high grade coal to lignite coal without first enlarging the grate surface and of course such a change involves considerable expense. Changing over to pulverized coal is also expensive.

Forced draft assists materially in increasing the capacity of lignite fired furnaces but the principal objection to forced draft is that if the air pressure is too high it will blow the light lignite fuel off of the grate up into the flues —*W. F. Schaphorst*

WASHINGTON NEWS

summarized by Loring F. Overman. WPB Doubles the Housing Quota; Ask Complete Data for A.C. Priorities; Timmis Issues Heating Repair Order; Oil Burners Restricted in East and N. W.

J. M. Fernald, chief, Air Conditioning and Refrigeration Branch, War Production Board.

Although hopes of "business as usual" have been abandoned in view of the size and scope of the planned war program, the high priority ratings that will of necessity be assigned to many branches of the heating, ventilating and air conditioning industries offer some degree of reassurance. Before discussing details affecting heating and air conditioning men, however, it is well to ask "What are these plans for the war program?" The answer is: In 1942—to step up present war production so that $47 billion will actually be expended in the war effort; in 1943—to turn into war channels nearly $80 billion, a sum equal to the entire American manufacturing and commercial effort during the 1929 boom period!

With such stupendous expenditures labeled by the President as "musts"—expenditures in *addition* to whatever civilian production may be permitted—it is inconceivable that any manufacturing plant or individual capable of assisting any phase of the war effort will long remain unemployed.

True, employment may not always continue to follow the pre-war pattern, for industry and labor are going to join the Army or Navy... regardless.

Industries now producing products needed either directly or indirectly in the war effort are fortunate. They will continue to produce present products in quantities dwarfing past dreams of volume. Included among these are the industrial producers of the ventilating and air conditioning field, and the industrial and defense housing branches of the plumbing and heating industries.

Firms unable to maneuver themselves into some phase of the defense building program appear to have but one alternative, conversion of their equipment to war production—with a minimum of delay.

As for manpower, the Army's sudden voracious appetite for men of all ages up to 44, with little regard for dependent status, and its sudden insistence upon "skill classifications" for men from 44 to 65, sets a new pattern which should permit each reader of HEATING AND VENTILATING to place a rough estimate upon his probable place in the picture of all-out war.

The first piece of patchwork in the new pattern is that the entire war plan has been changed. Instead of the mostly-Navy war originally visualized, official figures in Washington spell ARMY in capital letters.

Therein lies the key to the position to be occupied in the new program by heating, ventilating and air conditioning industries. Millions of men! Millions of new uniforms. Thousands of tanks, guns, planes, and miscellaneous equipment; hundreds of new or converted manufacturing plants to produce them; thousands of defense housing units to supply transplanted worker groups to be recruited from Army's new classified skills list!

More Ordnance Plants

Nearly all of the much-publicized first "wave" of ordnance plants started a year or so ago are now in operation; a second wave is slated to begin operation about mid-year, and a third series of plants or depots to cost more than $5,000,000 each has been announced by the War Department. The list grows daily, and will continue to do so until plans are completed.

Heating, ventilating and in some instances, air conditioning, will be A-1-a priority items in all of the plants currently authorized, as well as in those still to come. Details of the requirements are blanketed by censorship restrictions, but will be available to authorized persons at district offices of the U. S. Army Corps of Engineers, or at the offices of successful contractors, when announced.

Procurement Decentralized

In any consideration of the magnitude of the Army's new construction program it should be noted that the Corps of Engineers has decentralized its procurement system and that all details of construction projects of $5,000,000 or less are handled through district offices, usually with little or no publicity.

In general, no contracts for construction are now advertised from the Office of the Chief of Engineers in Washington. Since March 15 this office has conducted negotiations only for the award of contracts for larger projects, costing generally in excess of $5,000,000, or those of a special nature.

All other contracts for construction are now being handled by the field agencies of the Corps of Engineers—offices of the division and district engineers now located throughout the U. S. The local field office is, in general, charged with all steps concerning the execution of assigned work, including preparation of plans and specifications and other bidding documents, issue of requests for bids in the case of advertised contracts, and the submitting of recommendations for selection of contractors and the negotiation of contracts to be awarded on a negotiated basis.

Selection of Engineers and Contractors

Recommendations for the selection of contractors and architect-engineers submitted by Division and District Engineers will be cleared in Washington through the newly formed Construction Contract Board which, in turn, submits its findings to the Chief of Engineers for final approval.

The new Construction Contract Board, operative since March 15, performs functions previously assigned to the Construction Advisory Committee and the Contract Negotiation Board. The formation group formerly received applications and qualifications from firms desiring to be considered for War Department construction work, and made recommendations concerning selections for award of contracts. The Contract Negotiation Board actually conducted the negotiations.

The Construction Contract Board is composed of the following: Lt. Col. W. M. McKee, chairman, and H. W. Loving, both formerly with the Contract Negotiation Board; and R. H. Tatlow III, F. S. Harvey and A. J.

Hammond, all formerly with the Construction Advisory Committee.

The new board has offices in Room 4086, New Railroad Retirement Building, Washington. It has taken over all files and records of the groups it supersedes. Consequently it will not be necessary for contractors and architect-engineering firms to submit new applications and records if those formerly on file were kept up to date.

WPB Doubles Housing Quota

In addition to the Army's facilities program, WPB announced on March 17 that it had approved the construction of an additional 350,000 dwelling units for war industry workers, more than doubling the original defense housing program announced last September 19. The program was recommended by the National Housing Agency.

One hundred and fifty thousand of the newly approved units will be erected by Federal government agencies; the remaining 200,000 to be privately financed. Besides preference ratings assigned to the projects, additional assistance will be given to contractors to assure delivery of materials essential to approved construction.

A price of $6000 per family dwelling is placed on each family dwelling offered for sale, with $50 as the maximum monthly rental for the 100,000 privately financed dwellings to be available on a rental basis.

$14 Billion for Construction

The military facilities and cantonment program, the defense housing program, and the civilian construction to be permitted, adds up to an estimated total of $14 billion for 1942—some WPB officials state.

Elimination of all building materials beyond absolute necessity in war public works construction was ordered March 21 by Federal Works Administrator Philip B. Fleming. This order applies to the $300,000,000 war public works program.

General Fleming's order will reduce the use of critical materials and will divert man-hours of labor to other war production.

Colonel William N. Carey, Chief Engineer of the Federal Works Agency, issued instructions to regional engineers including:

"On all jobs now awarded for construction, construction materials and labor involved in all elements beyond bare necessity shall be deleted by change order. As an example of labor and material reduction, plastering will be omitted. Heating and plumbing pipe work shall be left exposed whether in wall chases or not. If damp-proofing is required on exterior walls above grade, it will be omitted along with lath and shaped metal beads at base and exterior angles."

Fans and Blowers

Liaison agencies between government and the heating, ventilating and air conditioning industries to be involved in so vast a program are the Industries Branches of WPB—the Plumbing and Heating Branch under W. Walter Timmis; the Refrigeration and Air Conditioning Branch, under J. M. Fernald, and the General Industrial Equipment Branch under C. S. Williams. The last, through its Fan and Blower Section, headed by George W. McCormick, Jr., chief, has jurisdiction over all fans and blowers of rotating or axial types. Excluded are desk and circulator fans and those used for unit air-conditioners and fan-motor-blower units used for domestic heating. Attic fans are also classified under the Consumers' Durable Goods Branch.

As explained by Mr. McCormick, the Fan and Blower Section is a subdivision of one of the few WPB Industry branches having horizontal jurisdiction over all types of industrial fan and blower equipment.

Whereas it is the duty of most Branches to limit the end uses of products for the purpose of releasing scarce materials for vital war needs, the General Industrial Equipment Branch is charged with arranging for production when vital war needs have been established. This branch is directly concerned with the expressed needs of Army, Navy and the Maritime Commission, and the surpluses or shortages it discerns have a direct bearing on the programs and limitation orders issued by other Branches whose chief concern is curtailment of non-essential uses.

Interviews at the branch indicate that the producers of heavy industrial ventilating equipment will be hard put to keep pace with the need to expand production facilities and construct both merchant and fighting ships. Conversely, troublesome days appear to be ahead for large numbers of manufacturers of small ventilating units. It is suggested that operators of such plants present their problems at once to Offices of Contract Distribution and to Ordnance District headquarters.

A.C. Branch Awaits Repair Order

Under J. M. Fernald, the new Refrigeration and Air Conditioning Branch, announced in last month's HEATING AND VENTILATING, is completing its organization chart, with Roderick Tait and Sterling Smith as the only principals to date. Expected momentarily is the issuance of a repair and maintenance order to facilitate purchase of materials for upkeep of existing civilian equipment.

Appointment of additional personnel to head sections devoted to simplification and conversion are also in the offing.

Heating Order P-84 Announced

Regarded as the most important development of the month in the Plumbing and Heating Branch was the issuance of Preference Rating Order P-84, designed to facilitate the maintenance and repair of existing plumbing and heating installations on farms, in residences, and in offices and apartment buildings. The order assigns an A-10 rating, usable by either installer or supplier, to obtain materials needed for emergency plumbing and heating repairs. The rating may not be applied to obtain copper already fabricated in sheets, wires, rods or tubes, or to any scarce materials which can be eliminated by substitution or change of design.

In issuing the order, W. Walter Timmis, Chief of the Plumbing and Heating Branch, said:

"The importance of maintaining existing plumbing and heating facilities is recognized in this order, but because the plumbing and heating industry is chiefly a metal consuming industry, every effort must be put forth to keep consumption of critical materials at the irreducible minimum.

"In other words, this order is not a guarantee that existing plumbing and heating facilities will be maintained in exactly their present state. For instance, a heavy brass chrome plate shower mixing valve would not be replaced by one of the same type. In normal times it has often been found that it is cheaper to replace than to repair.

"Replacement now can be made only if there is no possibility of repair. In cases where replacement is essential it will be found that the items now being produced are severely limited in number of types and styles, that the weight has been reduced, and that in many cases, less critical materials are being used in place of the customary materials.

"The intent of this order is not only to insure maintenance and repair, but also to insure that the products made available for that purpose are used only for *essential* maintenance and repair."

The order defines plumbing equipment as any equipment, fixtures, fittings, pipes, accessories or supplies of types used in, or connected to, water, sewer or gas systems, whether or not connected with a central system. It does not include, however, any tools for use in installation of repairs, or any hoses, sprinklers, or other device commonly attached to out-door faucets.

Heating equipment is defined as any primary heating unit used to provide building warmth or any accessories of such unit.

Emergency repairs are defined as those required by actual or imminent break-down of plumbing or heating equipment. It includes the emergency replacement of equipment which is worn-out or damaged beyond repair. It does not include installation of superior type equipment or substitutions more extensive than required to replace worn-out parts.

Other provisions of the order are as follows:

1. The A-10 rating may be applied by a simple indorsement on purchase orders or contracts.

2. Installers may not apply the rating to obtain delivery of materials on earlier dates than required to enable them to make emergency repairs.

3. A supplier may not apply the rating if he can make his delivery and still maintain a minimum working inventory.

4. The A-10 rating is applied automatically in the case of delivery to an installer of any plumbing and heating item, the cost of which is less than $5, provided that the total order placed by the installer is less than $10.

"Such deliveries," Mr. Timmis stated, "to which the rating is automatically supplied must be actual and *bona fide* purchases for less than $5. Similarly the over-all order must be for less than $10. Larger orders may not be broken down so as to bring them, by subterfuge, within the terms of this provision."

5. In the case of units costing more than $50, and worn-out or damaged beyond repair, the installer must attach to the purchase order a statement signed by him and by the ultimate user, certifying that repair is impracticable, and specifying the points at which the unit failed.

6. Provisions of Priorities Regulation No. 1 are made applicable.

Order P-84 is designed to fill a gap in the application of orders currently existing for repair and maintenance needs. Preference Rating Order P-100 for instance, assigns an A-10 rating for repairs and maintenance items but may not be used to secure repairs for retail or residential properties.

The new order, although making the A-18 rating extendible to all suppliers, including the manufacturer, does not permit the manufacturer himself to extend the rating. A manufacturer desiring priority aid to secure materials for supplies sold under P-84 must still use the Production Requirements Plan or the modified PRP.

Coincident with the issuance of P-84, the Plumbing and Heating Branch was subjected to a barrage of Washington newspaper criticism based on the claim that industries represented in the branch have been dealt with too leniently.

Criticisms were denied by Mr. Timmis, chief of the branch, who explained that any apparent lack of production-limiting orders issued by the branch was offset by a barrage of other WPB limitation orders which, in effect, stemmed at the source the supplies of scarce materials which would normally enter into the production of plumbing and heating equipment.

To limit the actual production of plumbing equipment in the face of a 1942 vital-to-defense construction demand that promises to be two billion dollars ahead of 1941 is hardly logical, executives of the branch commented. Instead, attention of the branch staff has been devoted largely to effecting economies in scarce materials by simplification or substitution.

To that end, four orders issued prior to P-84 effected savings of scarce materials by requiring simplification of valves, pipe fittings, metal jackets, fusible plugs, tri-cocks, soil pipes and soil pipe fittings.

On March 23, subsequent to the issuance of P-84, the Branch issued Schedule V to Limitation Order L-42, intended to save approximately 1000 tons of copper and brass by simplifying plumbing fixture fittings and trim.

Boiler Ceilings

Following industry meetings with manufacturers, wholesalers and jobbers of plumbing fixtures and cast iron boilers and radiators, the Office of Price Administration announced March 3 that it is conducting an investigation to determine what price ceilings shall be established to cover these products.

Questionnaires were sent to members of the industries for cost information. OPA is deciding now what the price ceilings for these commodities are to be. Increases, some as high as 15%, have been quoted on some items.

At the industry meetings, held at OPA offices in Washington on February 18 and 20 last, OPA officials discussed the price situation as affecting cast iron boilers and radiators and vitreous china and enameled cast iron fixtures.

At the time of the meetings Leon Henderson, Price Administrator, indicated that proposed increases would have a chaotic effect upon the building industry. He warned of OPA action unless prices are kept within reason.

New Advisory Committees

Formation of the High Pressure Valve Industry Advisory Committee was announced March 19 by the Bureau of Industry Advisory Committees. Carl M. Lynge is government presiding officer, and Mr. Timmis has been named alternate government presiding officer.

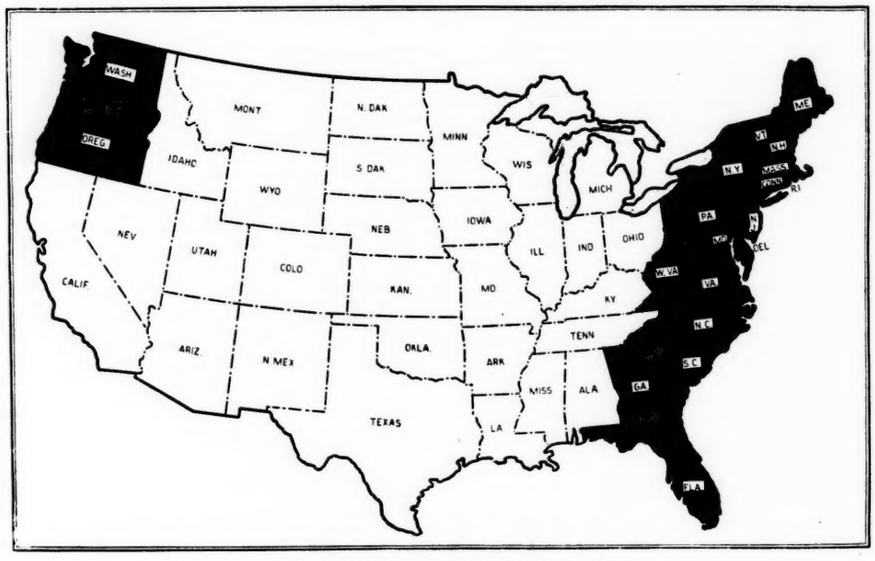
Committee members are: L. D. Seymour, Pittsburgh Valve & Fittings Corp.; C. S. Bigelow, Milwaukee Valve Co.; and R. L. O'Brien, Detroit Brass and Malleable Works.

Formation of the Fire Sprinkler Industry Advisory Committee was also announced March 19 by the Bureau of Industry Advisory Committees. George W. Angell of the Safety and Technical Equipment Branch, Fire Equipment Section, is government presiding officer. Committee members are: I. W. Knight, Grinnell Company, Inc.; A. B. Crowder, Crowder Brothers, Inc.; Frank J. Fee, Jr., Reliable Automatic Sprinkler Co., Inc.; and W. K. Hodgman, Jr., Hodgman Manufacturing Co.

New Appointments

Appointment of H. M. Brundage as chief of a newly-created Appliance Section in the WPB Plumbing and Heating Branch was announced March 16 by Mr. Timmis. The Appliance Section will be responsible for certain products which were formerly assigned to the Electrical Appliance and Durable Goods Branch. These include bathroom heaters, burners, broilers, bakers, circulators, fire-place logs, floor furnaces, cooking and instantaneous water heaters, warming ovens, radiant heaters, steam radiators, water heaters operating by gas, wall heaters, oil ranges, and coal stoves.

Before coming to WPB, Mr. Brundage had managed his own business, the H. M. Brundage Company, Richmond, Va. Previously he was general sales



OIL BURNER BLACKOUT MAP

The order in which new oil burner installations were banned and fuel oil sales restricted, a WPB order issued March 14.

manager of the Washington Gas and Light Company.

Appointment of Howard Coonley as chief of the Simplification Branch of the Bureau of Industrial Conservation was announced March 16 by Lessing J. Rosenwald, chief of the Bureau. Mr. Coonley, chairman of the board of the Walworth Company, replaces Dr. Edwin W. Ely, who recently was called back to his post as Chief of the Division of Simplified Practice of the National Bureau of Standards.

Mr. Coonley, president of the National Association of Manufacturers in 1939, is a former president of the American Standards Association and is now a director of that organization. In 1918 he was vice-president of the United States Shipping Board Emergency Fleet Corporation, and following the World War he was chairman of the First Chemical Warfare District in New England.

For fifteen years, Mr. Coonley has been chairman of the Manufacturers' Standardization Society for the Valve and Fittings Industry.

Jobber Priorities

Priority problems of heating and plumbing distributors, wholesalers and jobbers will be simplified by the use of a new application form to be known as PD-1X, and which is planned to be available early in April. Insofar as materials and supplies can be made available without interfering with the war effort, priority assistance will be given to distributors, wholesalers, etc., who apply on the new form so that they can keep sufficient stocks on hand to maintain essential productive and service industries in operation.

In recent months, distributors have been hesitant to make deliveries to retailers, restaurants, and other important users who cannot furnish priority rating certificates, because the distributors were afraid that they would not be able to replace the material in their own inventories. Use of the new form will enable distributors to request preference ratings for essential supplies without receiving or extending a rating on every individual order which they fill.

Oil Burners Restricted

Need for conserving available fuel oil supplies so that they may be used to the maximum in promoting the war effort prompted issuance on March 14, by WPB, of the L-6 limitation order on consumption of fuel oil.

The order is applicable throughout 17 Eastern States, the District of Columbia, and the two Pacific Coast States of Oregon and Washington.

It prohibits, with certain essential exceptions, all further installation of oil-burning equipment by industry and home owners. Also, it authorizes action which will result in a substantial number of users of industrial fuel oil changing to the use of available substitute fuels, such as manufactured gas, coal, wood and sawdust, and requires the maximum utilization of standby facilities which operate on such substitute fuels.

Discussing the new order, Deputy Petroleum Coordinator Ralph K. Davies said:

"The measure just taken by the War Production Board is necessitated by the increasing war and civilian requirements which cannot, under present conditions, be met in their entirety because of the diversion and loss of a part of the facilities for transporting petroleum and petroleum products to the Atlantic Seaboard and to the Pacific Northwest.

"Only by converting wherever feasible to the use of some other available fuel, and by taking steps which will prevent new and additional demands for oil, can a serious scarcity of fuel oil for essential war services and civilian uses be avoided in the affected areas. No home owner who does not have standby facilities need fear, however, that he will be deprived by this order of the use of his oil heater or of the right to obtain repair parts required to keep it in serviceable condition."

Specifically, the order:

1. Prohibits the delivery of fuel oil to any consumer if that consumer has standby facilities designed to use a fuel other than fuel oil, electricity, natural gas, or mixed natural and manufactured gas, and for which a supply of such fuel is available, where such standby facilities are not being operated so as to effect the maximum reduction in the consumer's fuel oil requirements.

2. Prohibits deliveries for the operation of new or additional facilities unless these were installed within 30 days after effective date of the order, or unless, in the case of new construction, the equipment was specified in the construction contract and the foundation under the main structure in which the equipment is to be installed was completed within the same 30-day period. This restriction does not apply, however, where a consumer cannot reasonably use a substitute fuel other than electricity, natural gas or mixed natural and manufactured gas, because of technical utilization factors or process requirements.

3. Prohibits deliveries for the operation of facilities converted from other fuel to fuel oil unless the conversion is completed within ten days after the effective date of the order.

4. Authorizes the Director of Industry Operations of the War Production Board to suggest that a consumer convert from use of fuel oil to use of an available substitute if, upon investigation, it is found that the consumer's facilities may be converted without unreasonable expense and without causing him exceptional or unreasonable hardship. The same provision arms the Director with authority to forbid further deliveries of fuel oil for use in such facilities, if the consumer fails to convert.

5. Grants the Director of Industry Operations power to issue, from time to time, "specific directions directing or forbidding deliveries of fuel oil to any consumer." Specifically exempted from restriction, however, are deliveries of fuel oil for use in internal combustion engines.

Provision is made in the order for appeals by persons who consider that compliance would work an exceptional and unreasonable hardship on them.

A.C. Priorities

Persons seeking to obtain preference ratings in order to purchase air conditioning or commercial refrigeration equipment were urged by the Air Conditioning and Commercial Refrigeration Branch March 25 to submit in detail all the information called for on application forms PD-1A.

The Priorities Section of the branch has been experiencing much difficulty and long delay in attempting to appraise applications because of the sketchy information submitted. Many applications have had to be returned because some of the questions contained in the information sheet accompanying the PD-1A forms have not been fully answered.

Branch officials said that information received in response to Questions 2, 3 and 7 has been particularly sketchy, and the result has been to handicap the priorities analysts in their efforts to act quickly on all applications.

Question No. 2, relating to the function of the equipment desired to be purchased and the type of establishment in which it would be installed, is extremely important, officials said. Applicants must furnish information under this question on whether the equipment would replace, repair or expand existing facilities, and must state definitely whether or not a complete new installation is contemplated.

Question No. 3 requires a complete description of the material wanted, and the name of the supplier. Under this question, applicants also must give the dates of any other preference rating applications they may have pending, and state whether they intend to file additional applications.

Question No. 7 relates to the supply situation in the event a rating is not obtainable. If an applicant's request is for various products which will go into inventory, the present inventory position on each item should be clearly outlined under this question, and the per cent of annual consumption of present inventory should be stated.

If these and other questions are fully answered, officials said, they will be able to make an intelligent appraisal of the need for and essentiality of the products or raw material requested.

Heating a Mountain-Top Radio Station

(Left) View of station W39B antennae on top of Mt. Washington heavily coated with frozen fog formation. Rime driven by the wind often forms deposits five or six feet long in a single night. (Above) General view at the summit of Mt. Washington showing weather bureau station buildings and station W39B building under construction.

Data: At the site of the building the average wind velocity from December to March is about 55 mph, with a recorded high of 231 mph. The mean temperature runs from about 5F in January and February to 45F in the summer months. Lowest temperature in the last eight years is —46F and the highest temperature reached in the summer is 71F. Snowfall averages more than 200 inches a year.

These were the figures which caused brow-wrinkling on the part of heating engineers working on a new building housing station W39B, new frequency modulation transmitter of the Yankee Network, located on the top of Mt. Washington, New Hampshire, next to the weather bureau station.

As a matter of fact the station building, designed by architect Stanley Davidson, Jr., of Boston, is, of course, adapted to its unique site and constructed to offer maximum protection from the near-arctic weather conditions. It is a well-insulated steel and concrete structure, and while plenty of heat was needed there was no particular problem in laying out a warm air system using two G.E. oil-fired winter air conditioners with a total rated capacity of 400,000 Btu per hr. Two units were used because of the danger to the attendants and the station equipment if a single heating unit failed.

The really interesting problem was that of installing the units. There is a toll road up the mountain, but the eight-mile trip up is not an easy one for a loaded truck under any circumstances. The installation crew of the Eastern Slope Merchandise Corp., however, was lucky. On the day chosen for the trip, the weather was considered good. It was a nice late autumn day in the valley. Even so, the men had to get out several times and shovel snow to clear a path for the truck. They unloaded the truck at the summit in the teeth of a sub-freezing gale. During the last week of the installation the weather became so unfavorable that the insurance company would not approve trips up the mountain toll road for ordinary cars or trucks. The installation crew then had to go up in a general contractor's truck driven by a specially qualified driver. The installation was concluded just in time, for within two days after the men left, a storm came up which isolated the summit.

Simple Test for Oil in Boiled Water

Take an ordinary clean test tube, fill it to a depth of about two inches with the feed water you want to test and shake it in your hand with your thumb over the opening for a few minutes. If at the end of a sufficient period there is an accumulation of bubbles on the surface of the water you can be almost positive that there is oil and plenty of it in the water. The test is quite sensitive, and one any boiler operator can perform with accurate results. If at the end of the shaking period there is no evidence of bubbles, you can be pretty sure that the amount of oil in the water is too little to cause harm.—*W. F. Schaphorst.*

Theory Vs. Practice

Reducing Fuel Consumption

By T. W. REYNOLDS

MANY a suburbanite builds a fire in the open fireplace in the early fall and late spring in the belief that he is saving a certain amount of coal or oil which would otherwise be required in the boiler for house heating. Insofar as a coal fired plant is concerned he probably does because the maintenance of a banked fire is eliminated and even with an oil-fired plant a saving is also made, providing the burner is not operated for heating at any time in the same day or succession of days that a fire is made in the fireplace.

A fireplace pumps warm air out of the house, thereby increasing the infiltration of cold air in an amount equal to the air pumped out, so that if the burner is operated for some period of the day to warm up the air in the house and the fireplace is used for some other period of the day to pump the warm air out and bring cold air in nothing is gained thereby. The open fire warms the room it is in by radiation to walls, furniture and body, but only makes all of the other rooms colder, and as a consequence more frequent operation of the burner becomes necessary.

Building a fireplace on the warm or lee side of the house will make the room it is in uncomfortable due to cold currents of air crossing the room from the cold or windward side on their way to the fireplace. This condition can be prevented by building the fireplace on the windward side so that the cold air which enters on that side will be drawn directly to the fireplace. Another advantage of this location is the protection from the weather which the heavy masonry fireplace affords for a fair portion of that side, and a likelihood that the doors and windows will therefore of necessity be generally located on the lee side where they should be in order to avoid drafts.

A fireplace is at its best and only does real heating after it has been used for a few hours so as to thoroughly heat all of the masonry up to a temperature where the masonry will act as a large hot radiant panel and where its mass and accumulated hot ashes will continue to give up heat to the room for many hours after the fire has gone out.

The savings in fuel made possible by reducing room temperatures during the night is a question that has been argued long and hotly between those who believe in the practice and those who question whether any saving that could be obtained would be enough to justify the extra cost introduced by the use of a clock thermostat. Estimated savings vary according to the estimator from 7½% to 30% by the more optimistic, while the usual assumption is about 10%, probably for no other reason than the common preference for this figure whenever there is no definite information on the matter.

Obviously, the heat given up during the night by the walls and building contents in cooling must be replaced by an equal amount of heat in the morning to bring everything back to normal temperature, but on the other hand it is just as obvious that the rate of heat loss from the structure decreases as the average temperature of the house is lowered, and in this respect a saving in fuel is made. This saving is dependent upon the extent and duration of cooling. For example, assume a daytime indoor temperature of 70F and the temperature from 10:30 p.m. to 6:30 p.m. cooling from 70F to 55F, the thermostat setting at night. For these conditions, the indoor temperature will be

$$\frac{(16 \times 70) + (8 \times 55)}{24}$$

or 65 F. With an average outdoor temperature during the heating season of 40.7F (New York), the fuel saving for this location would be approximately

$$100\% \times \frac{70 - 65}{70 - 40.7} \text{ or } 17\%.$$

No doubt the real saving in connection with a night set back thermostat is through elimination of the burner off-period losses. During the night off-period of the burner the refractories, boiler and water cool and lose their heat up the chimney usually but once only, whereas with occasional burner operation during the night this loss would take place each time the burner stopped. Similar savings in fuel can be made by setting the thermostat lower whenever the house is left unoccupied for a major portion of the day. If the burner is turned off at the switch there is the added factor of safety while everyone is away.

A partial offset to the nightly saving is the higher stack loss on the pick up load in the morning as the boiler water is then maintained at a higher temperature, so that less heat is absorbed and more heat goes up the chimney. On the other hand, this apparent disadvantage may in reality become an advantage, for the longer early morning run with its higher combustion temperatures and shorter firing intervals tends to maintain the boiler in a cleaner condition and to consume any unburned residue deposits. The longer than normal run also maintains steam or hot water in the radiators, thus making for more even or balanced heat throughout the house, an improvement which becomes especially noticeable where the system is one that does not

ordinarily provide satisfactory heat. The advantages and disadvantages as outlined become more pronounced, with increased rate of heat loss of the structure, with night set back lowered in its setting, with increased duration of set back and with increased severity of the climate for the particular season or locality in question, as all of these factors increase the length of the warming up period.

Some object to uncomfortably low temperatures of building or furniture in the early morning though this objection hardly seems warranted as the furniture is not much occupied at such times and it only takes a few minutes to warm up the air in the house. From personal experience, the writer has found that his home is more comfortable in the morning at 60F on pick up load with the heated air in motion than it is later on at 70F with no heat on and the air stratified or practically motionless at the so-called *cold 70*.

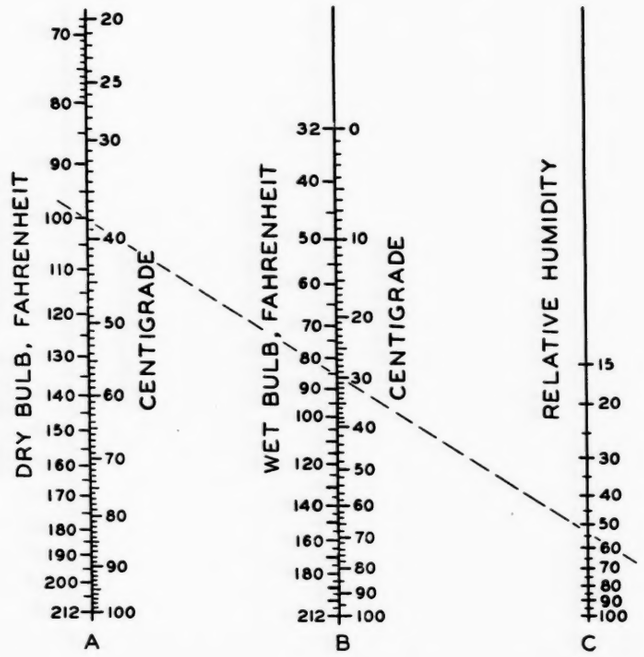
Undoubtedly the saving made by the use of a night set back thermostat is considerably greater than calculations show because the night set back occurs at a time when the greatest saving is possible. For example, the average outdoor temperature as given in the previous example represents an average of both day and night time temperatures and is therefore not a true average for night time temperatures, which are usually lower. Again there is the obvious fact that no sun shines on the house at night to retard the rate of heat loss from the structure, while still another factor of saving is the fact that the duration of lowered temperatures is longer than the 8 hours as given in the previous example, simply because the temperature of the house cannot be immediately raised to 70F at the given starting time of 6:30 a.m.

Incidentally, wind plays no favorites as between day and night, and while more noticeable at night when things have quieted down, is actually one mile less in average velocity at night for the city of New York. For this locality, the average wind velocity for last January was 12 miles per hour from 10 a.m. to noon, 13 miles per hour from noon to 3 p.m. and back to 12 miles per hour thereafter for the completion of the cycle. The wind as shown is slightly greater in average velocity during the early afternoon (about 10%) and in passing it may also be stated that it averages about one mile less in velocity in the summer months.

The night set back thermostat yields the best results in those houses where the heat loss is high, as with greater size of the structure, increased severity of climate and exposure, or absence of insulation, weatherstripping and storm windows. If the bedroom windows are left open at night with bedroom doors wide open to the rest of the house, still further savings are made for the night time setting of the thermostat prevents the thermostat from continuously calling for heat as it otherwise would with consequent escape of heat out of the opened windows from radiators whose capacities are greatly increased by the cold active air. These are all factors of savings of known existence, but of extent unknown and indeterminable by slide rule manipulation.

It may seem foolish to claim that a saving in fuel can be made by keeping down the roll screens or shades at windows during the heating season, but everyone knows that the hot air from radiators readily contacts the cold glass of windows immediately above with resulting loss of heat. When the screens are down their fine wire mesh prevents such contact and the heat goes up along the screens and not through them to the windows, as can be readily proved by smoking at such a screen. Screen doors at French doors are also of help.

In connection with screens it is interesting to note that any fireplace screen which is spark proof in more than name only is more or less heat proof. A major portion of the radiant heat rays never strike at the proper angle to be in line with the minute openings of the wire mesh, hence, cannot pass through the screen and heat the room.



To Determine Relative Humidity Quickly

The accompanying chart is handy for quickly determining the relative humidity from known wet and dry bulb temperatures. Tables and computations are unnecessary.

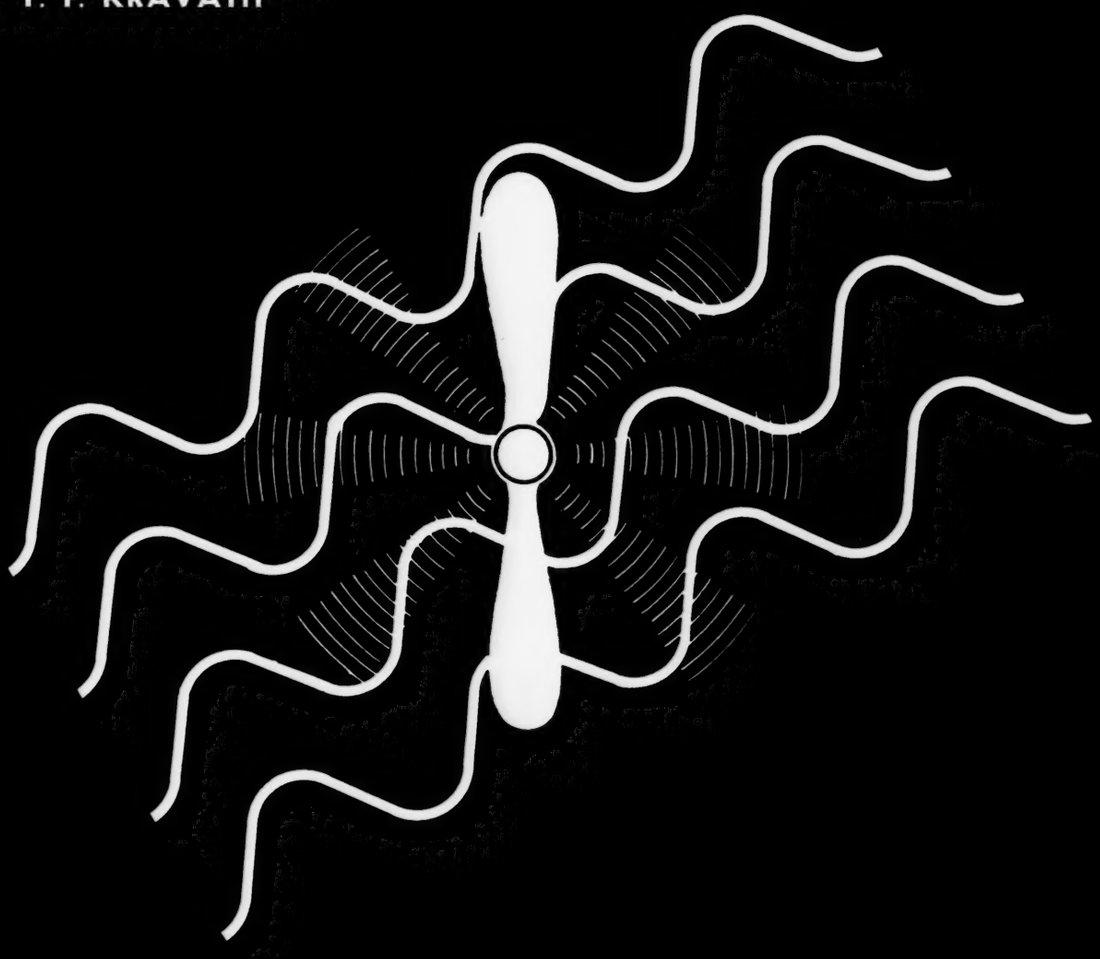
Run a straight line through the dry bulb temperature, Column A, and the wet bulb temperature, Column B, and the relative humidity is found at the intersection with Column C. Thus if the dry bulb temperature is 100F and the wet bulb temperature 85F, the dotted line drawn across the chart shows that the relative humidity, Column C, is 54%.

An advantage of this chart lies in the fact that it gives temperatures in both Fahrenheit and Centigrade scales.—*W. F. Schaphorst*

(Left) Chart for determining relative humidity quickly from wet and dry bulb readings in either Fahrenheit or Centigrade scales.

INDUSTRIAL EXHAUST VENTILATION

PREPARED ESPECIALLY
FOR HANDY REFERENCE
BY F. F. KRAVATH



AN OUTLINE OF PROCEDURE FOR DESIGNERS AND PLANT ENGINEERS IN PLANNING EXHAUST VENTILATING SYSTEMS FOR INDUSTRIAL DUSTS AND FUMES

HEATING AND VENTILATING'S REFERENCE SECTION

4

AN OUTLINE OF INDUSTRIAL

BY F. F. KRAVATH †

There is hardly an industrial plant that does not or could not use some form of exhaust ventilation to carry away harmful or unpleasant dusts either to waste or to a dust collector; to remove from a working area toxic or disagreeable fumes or gas; to remove moisture-laden air from spaces where open vats are evaporating water into the atmosphere; or to exhaust relatively high temperature heated by a process, body heat, or the sun to a point where the condition stops or retards work.

The subject itself is not a particularly simple one and, especially to those approaching the subject for the first time, detailed explanations, data, and information about each step can easily become so involved that the user fails to get a comprehensive picture of what he is trying to do before he begins the project. It is the purpose of this section to present a reasonably complete outline of the subject as a whole in a relatively brief treatment to overcome the objection to the more detailed and more complete, but at the same time far lengthier and consequently somewhat more confusing, books on the subject.

This Reference Section is divided into two parts: the first, which begins on this page, is devoted to the technical phases of the subject; the second part is made up of brief illustrated descriptions of a number of actual installations of various types of exhaust systems and covering a fairly wide scope of industries and equipment combinations.

The subject of industrial exhaust ventilation, like the subjects of air-conditioning and, let us say, machine design, is sufficiently complex so that it would require a child-like faith to believe that it may be learned in five easy lessons. Systems differ one from the other so that prospective systems cannot be modeled after existing ones without any additional investigation. Fortunately, however, questions to be answered in each individual design can be outlined in convenient form to serve as a guide in the design of exhaust systems.

In the pages following, we shall set forth a guide (in outline form) to be followed in the design of an industrial exhaust ventilation system of any type, an explanation of each heading and sub-heading in the guide, including illustrations, and a discuscussion of the proper combination and sizing of the elements comprising a system. In explaining the guide we shall set forth the many possible system types, arrangement of equipment, and the individual equipment types open to the designer's discretion and judgment. Each is the result of someone's careful analysis and study in attempting to meet an existing or contemplated condition. To decide on any certain system type before considering any of the others is as wrong as to decide on the size of the system before considering the individual machines to be exhausted. In the explanation of the proper combination and sizing of the system elements will be included essential data necessary for the engineering computations involved. However, where it is necessary that the designer investigate any aspect more thoroughly than it can be covered here, references are provided.

†Lieutenant (jg), Civil Engineer Corps, U. S. Naval Reserve.

NOTE: The opinions, statements, and recommendations expressed in this article are the author's own and are not official statements regarding engineering practice of the U. S. Navy.

GUIDE FOR DESIGN

1. Analysis of room or area to be ventilated:
   a. Dust count or fume study of atmospheric conditions in room concerned to determine the need for exhaust or other ventilation;
   b. Study of each machine within room to determine its contribution toward atmospheric pollution and its need for enclosure, hooding and exhausting;
   c. Study of machine layout, operator's movements, machine's movement, amount of material of waste character produced beside dusts or fumes;
   d. Number and combination of machines used at various times throughout the shift or day, and the proportionate time during each shift that each machine is used.

2. Type of system to be used (determined by the foregoing):
   a. Natral draft system;
   b. Simple dilution system utilizing exhaust or blowing fans;
   c. Venturi ejector system;
   d. Proportioned main exhaust system, with or without filtering medium;
   e. Two or more graduated main systems, with or without filters;
   f. Plenum chamber system (overhead, underground or vertical), with or without mechanical conveyor;
   g. Combinations of the above, or systems utilizing boosters for long drags, etc.

3. Component parts of system (determined by choice in foregoing):
   a. Hoods (shape and construction) and additional devices;
   b. Branch and main piping, including all hood connections, connections between piping, filter and fan connections, and fan discharge;
   c. Settling chamber (gravitational or inertial), cyclone, centrifugal cleaner, cloth or paper or glass filter, oil or water washer or scrubber, electrostatic precipitator, or other cleaning device, or combination of these or other devices;

EXHAUST VENTILATION

d. Single or multiple disc or centrifugal fans arranged in series or parallel;

e. Venturi primary jet;

f. Fan motor;

g. Drive or transmission (direct-coupled, belting, gearing, chain, hydraulic, coupling, group drive);

h. Filter cleanout, including bin or conveyor construction and design to prevent formation of new dust nuisance or hazard.

ROOM ANALYSIS

a. Dust, Gas, or Vapor Concentration

The need for determining dust, fume, gas, or vapor concentrations is not always apparent. However, it is always helpful and may be the means of saving much unnecessary expense. From the practical standpoint, we are not so much interested in whether the dust count is 40,000,000 or 60,000,000 particles per cubic foot as we are in disclosing hazards not readily visible to the human eye. For instance, atmospheric pollution by free silica dust or dust largely of free silica of which the concentration may be no more than 20,000,000 particles per cubic foot, but in which the particle size is extremely small, such as less than 5 microns, may be both unnoticed and quite hazardous. Again, it serves as an excellent indication of the efficacy of the exhaust system when completed. Comparative atmospheric concentrations of a contaminant before and after the installation of the ventilating system will determine the efficiency of removal.[1]

Where a plant has an unusually serious dust or fume problem and has assigned one of its staff to study it thoroughly, it is an excellent step to invest in an appropriate counting and sampling device such as the Greenburg-Smith impinger, electric precipitator, or other suitable sampling device. However, where the problem is temporary or the plant small, it is recommended that an engineer experienced in dust control, or an industrial hygienist, be consulted.

b. Machine Study

While dust, fume, gas, or vapor determinations are often necessary and important, they cannot take the place of the individual study necessary for each machine. The relative amounts of contamination contributed by each machine must be investigated carefully. It is insufficient to study only those machines in which material is being removed from some item of manufacture. Every machine in the room in question must be studied. It must be borne in mind that almost every mechanical movement is accompanied by the movement of the surrounding air due to agitation. Whereas dust will settle out of still air, it is capably supported and thoroughly scattered by agitated air. Hence, the necessity for an investigation of each machine is apparent.

Wherever it is possible—and this is the most important single rule in dust control—each machine creating, dispersing, or agitating dust should be enclosed as completely as practicable. If this could be done in all cases, the exhaust system could be reduced to a fraction of the size and cost ordinarily necessary. Since the amount of air to be exhausted from each dust creating machine is not directly determined by the amount of dust created but rather by the size of the opening or gap in the enclosure around a machine, it is obvious why this opening should be reduced to minimum.

c. Machine Layout

Before attempting to decide just what type of exhaust system should be used, a careful study should be made of the existing machine layout. It is always a good idea to make a scale drawing of the machine layout, if none is already available, and superimpose on the prints or other reproductions of the drawings the various ideas suggested. The relationship of all pertinent physical equipment, such as floors, walls, columns, trusses, light standards or supports, pipes, conduits and any other item which would in any way affect or interfere with any part of any proposed system, should all be spotted on the prints. This is extremely important. It will help determine the type of system to be used and will prevent costly field difficulties, holdups, consultations and subsequent makeshift changes. The types of systems best suited to any existing or particular set-up of machinery will be explained later under Type of System to be Used.

Of great importance in the analysis of the room or area to be ventilated is the study to be given on the movements of the operator and the characteristics of the machine. Some machines are stationary, having only one rotating part within (which rotates on a fixed axis). Others have every possible type of movement. There may be complicating factors which will demand special treatement in both hood and piping designs.

Another important factor to be studied at every machine is the kind of dust or dirt produced and the amount of it. It is obvious that different treatment is necessary for extremes of fine and coarse material. It is rare that heavy, coarse material will be conveyed the 1/16 mile or so between hood and cleaner of an average exhaust system. Usually, in proper designs, the material is dropped out of the air stream at the earliest possible point in the system. In many cases, the hood serves the double purpose of trapping the contaminated air and dropping the heavy entrained material out of the air stream. In any event, the machine should be studied to determine the feasibility of and the proper location for such traps. (Traps will be discussed under Hoods later in the article.)

d. Number of Machines

One of the most important points to be covered in the analysis and one which will largely determine the type of system to be used is the accurate determination of the number of machines used at any one time (and at various times) and the relative location of the machines in use. It is obvious that a room containing 30 machines of which no more than 20 are ever used at any one time is not economically exhausted if, by necessity, the entire 30 machines must be continually exhausted. On the other hand, it is no simple matter to design a system so flexible that only those machines in operation need be exhausted. For reasons which will be explained later under Piping and Type of System, it is usually necessary to accept a compromise; that is, under minimum conditions of use, it is neces-

[1]The technique of dust counting is covered in a previous article by the author in the March, 1940, issue of HEATING AND VENTILATING, under the title "Dust Control."

VARIOUS TYPES OF EXHAUST VENTILATING SYSTEMS

ALSO SEE FIGS. 8-11, INCL.

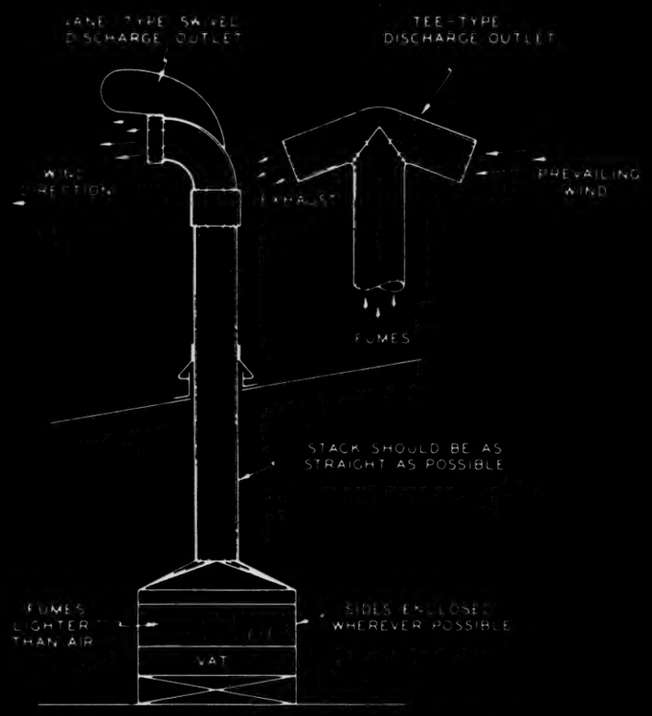


FIG 1 - NATURAL DRAFT EXHAUST - ILLUSTRATING DIFFERENT TYPES OF NO-BACK-DRAFT OUTLETS.

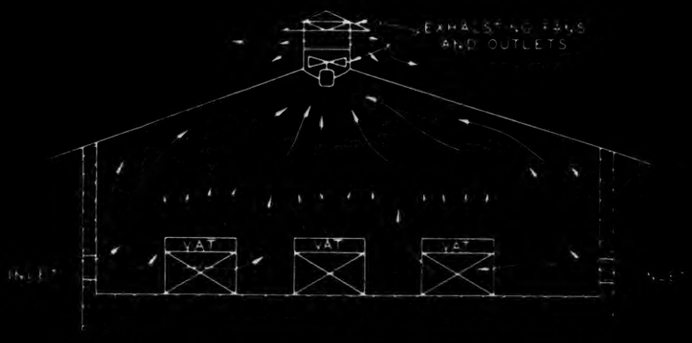


FIG 2 - DILUTION SYSTEM FOR LIGHTER-THAN-AIR NON-TOXIC FUMES. NOTE THAT INLETS ARE KEPT LOW TO PREVENT SHORT CIRCUITING.

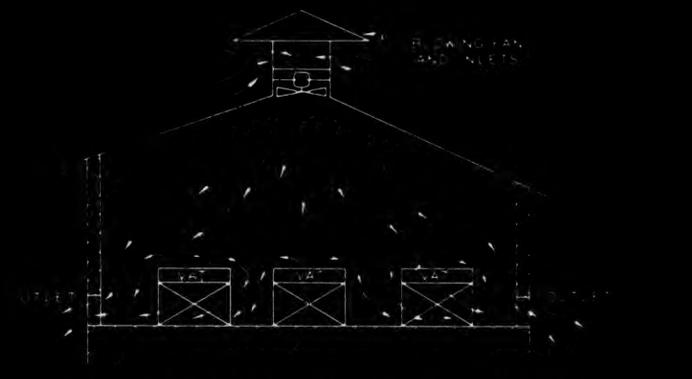


FIG 3 - DILUTION SYSTEM FOR HEAVIER-THAN-AIR NON-TOXIC FUMES. OUTLETS MUST BE KEPT LOW TO PREVENT HIGH FUME CONCENTRATIONS.

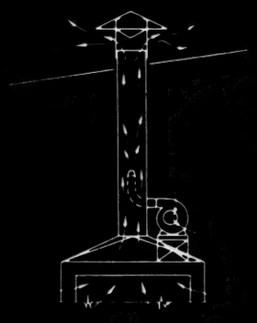


FIG 6 - STRAIGHT TUBE EJECTOR USING A PRIMARY BLOWER.

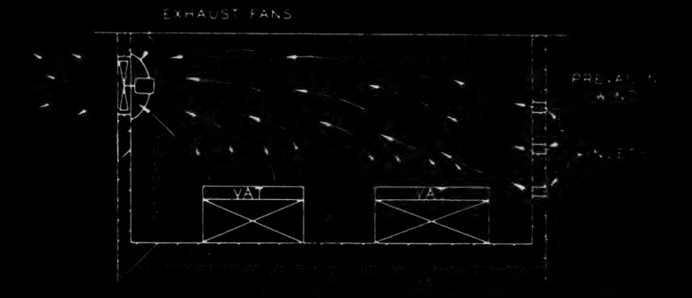


FIG 4 - DILUTION SYSTEM USING PREVAILING WIND DIRECTION FOR BETTER CONTROL OF LIGHTER-THAN-AIR FUMES.

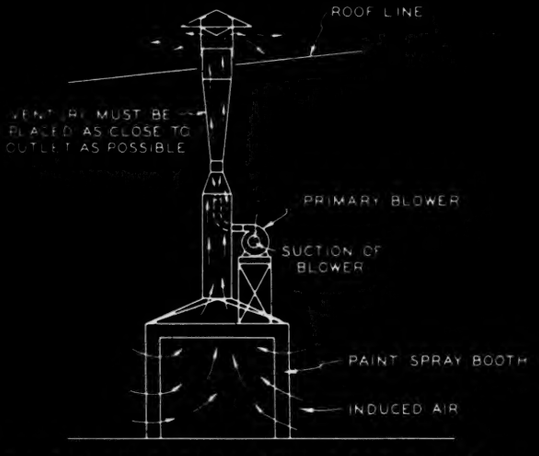


FIG 7 - ILLUSTRATING VENTURI EJECTOR SYSTEM OPERATED WITH PRIMARY BLOWER.

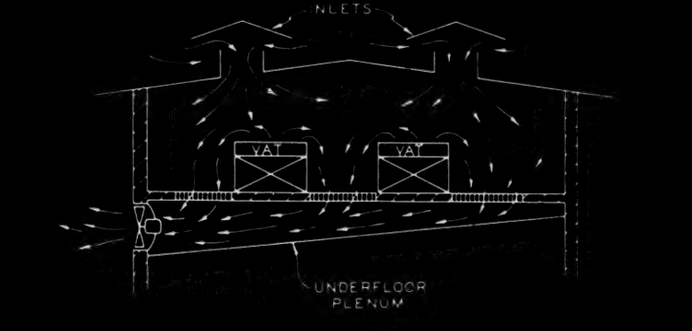


FIG 5 - DOWNDRAFT DILUTION SYSTEM FOR HEAVIER-THAN-AIR FUMES UTILIZING GRATINGS AND EXHAUSTER DUCT.

sary to exhaust more air than would normally be drawn in these machines operating. However, this condition can be considerably mitigated by using certain design types. Whether these types are warranted by the economic factors involved, we shall attempt to help the reader decide.

TYPE OF SYSTEM

Based on the analysis described previously, there will be one or more types of exhaust or ventilation systems which will be the better fitted to meet the problem and the conditions at hand. In order that the reader may make an intelligent choice, the general characteristics of the various types of systems will be described.

a. Natural Draft

One of the simplest types of systems used in industrial exhaust ventilation is the natural draft system. In such a system, as shown in Fig. 1, a hood is constructed over the vat, pan, table or other fume producing object. To the hood is connected a vertical stack and a discharge outlet at the roof. Care must be exercised, in such an installation, to design the outlet so that no back drafts will blow down the stack and nullify whatever good the stack might otherwise do. Shown are two types of outlets which prevent back draft. While there are other types, these are the most widely used.

In a system of this type, the static head or pressure causing airflow or gas flow up the stack is caused by the difference in weight of the volumn of gases within the stack and a column of air the same height. Hence, it is apparent that a system of this type functions only when the density of the gas within the stack is less than the density of the surrounding air. The lower the density of the gas, the more satisfactorily will the system function. (Such a system is valueless for the removal of dust unless the dust is microscopic in size and surrounded by heated air or some other lighter-than-air medium.)

Since air flows through a stack by virtue of a difference in air density between the source being controlled and the surrounding air, this difference can be related to temperature, and the volume of flow computed by means of the following formula

$$Q = AV = 8.02\ A \sqrt{\frac{H\ (t - t_o)}{460 + t_o}} \quad (1)$$

where

Q = volume of air flow, cu ft per sec;

A = area of stack, sq ft;

H = height of stack, ft;

t = inside air temperature or temperature within hood located at source to be controlled, F;

t_o = outside air temperature, F.

The area of the stack should be chosen so that the air velocity does not exceed 4 ft per sec.

b. Simple Dilution

The dilution system, equally effective for extremely fine dusts and fumes, gases or vapors, is based on the exhausting from the work area of such a great volume of contaminated air (with its consequent replacement by fresh air) that the rate of production of fumes is relatively low, with a consequent contaminant concentration within safe limits or standards. Where the gases given off are lighter than air, a system such as shown in Fig. 2, utilizing exhausters located in the roof, works very well. Where the gases or fumes are heavier than air, location of the exhausters under the floor, if done without any great expense, will provide an effective exhausting arrangement. However, due to the miscibility of gases, it is unwise to go to extremes to obtain downdraft exhaust in a simple dilution system. The main feature of this system is *dilution*, not airflow control. The rate of fume or gas production should be calculated (with the help of a chemist, if necessary) and enough air should be circulated to dilute the contaminating mixture down to safe limits.[2] In some cases it may prove more effective to locate the fans in the ceiling or roof and use them as blowers, rather than exhausters. In this case, outlets to the atmosphere should be provided close to the floor as shown in Fig. 3. Variations of this type for reasons of room or fixture arrangement or to make efficient use of a prevailing wind are illustrated in Figs. 4 and 5. Since such systems, in general, rely on the circulation of relatively large volumes of air for effectiveness, *the cost of equipment grows excessive where other than small quantities of fumes or other contaminants are produced.* The simple dilution system cannot be used economically and effectively for exhausting large quantities of fumes or gases under conditions involving high rates of production. Local exhaust systems must be utilized.

c. Venturi Ejector

Occasionally in exhaust design it is desired to exhaust corrosive vapors or mists, hot gases, or materials which on coming into contact with the blades of a fan would condense and stick there, thus reducing the efficiency of the fan considerably and perhaps making it inoperative due to unbalance or other reasons. In such cases, it is desirable mechanically to exhaust the entrained material without passing it through a fan. One such system, called the venturi ejector system, is illustrated in Fig. 6 while another variation of the same type is shown in Fig. 7. In Fig. 6, a hood surrounding an operation, such as paint spraying, is being exhausted. Close to the outlet to the roof the discharge piece is replaced by the venturi tube. A small blower handling room air discharges a high velocity stream or jet into the center of the venturi tube in the direction of exhaust flow and shortly in front of the converging section. (See Fig. 12 for proper proportions of yenturi ejector.) The impact of the high velocity air on the relatively slow moving air in the tube causes an increase in velocity of the slow moving air with a subsequent decrease in velocity of the jet air. The result is ejection of the entire mixture at the discharge. Due to the rarefaction of the air in the tube shortly before the mixing chamber (on the upstream side) a negative pressure or suction is set up, inducing flow through the entire system up to the mixing chamber.

Such a system should be designed so that resistance to flow in both the primary jet tube and the exhausting set-up itself is reduced to a minimum. Any unnecessary resistance will materially reduce the amount of air induced. In every case, the ejector unit (the venturi) should be placed at the tail end of the system. Such a system will not function against any but the slightest resistance on the discharge side of the ejector, while, if necessary, an appreciable resistance can be worked against on the suction side. For such a system to function satisfactorily, it is necessary that the primary jet velocity be of a high order, hence the need for a primary blower capable of developing the necessary pressure. All of the pressure (with the exception of a small amount of duct friction) will be due to the conversion of the relatively low velocity blower discharge air to very high velocity jet air, in the final cone. Following is a performance formula developed by the writer[3] which, when used with the chart in Fig. 13 for values of the constant K and a venturi ejector such as proportioned in Fig. 12, can be used in the design of venturi ejector systems:

$$SP = \left(\frac{CFM_1 + CFM_2}{A}\right) \times$$

[2] See "Economical Dust Control with Low Resistance Exhaust Systems, by the author, HEATING AND VENTILATING, October, 1940.

[3] See HEATING AND VENTILATING, June and August, 1940.

VARIOUS TYPES OF EXHAUST VENTILATING SYSTEMS

(ALSO SEE FIGS. 8-11, INCL.)

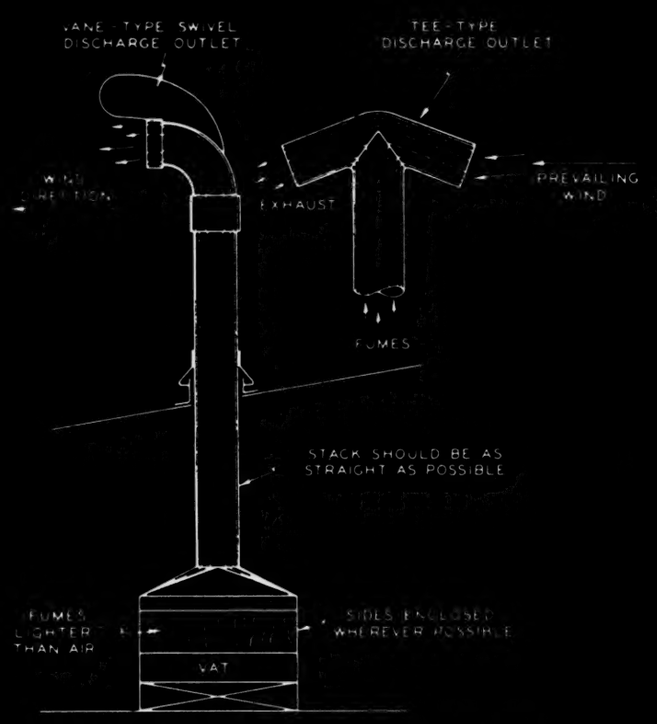


FIG 1 - NATURAL DRAFT EXHAUST - ILLUSTRATING DIFFERENT TYPES OF NO-BACK-DRAFT OUTLETS.

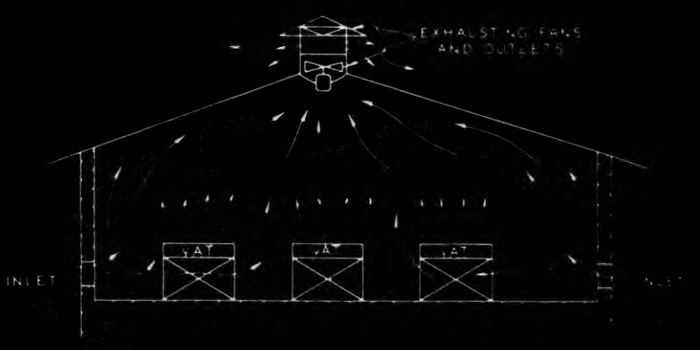


FIG 2 - DILUTION SYSTEM FOR LIGHTER-THAN-AIR NON-TOXIC FUMES. NOTE THAT INLETS ARE KEPT LOW TO PREVENT SHORT CIRCUITING.

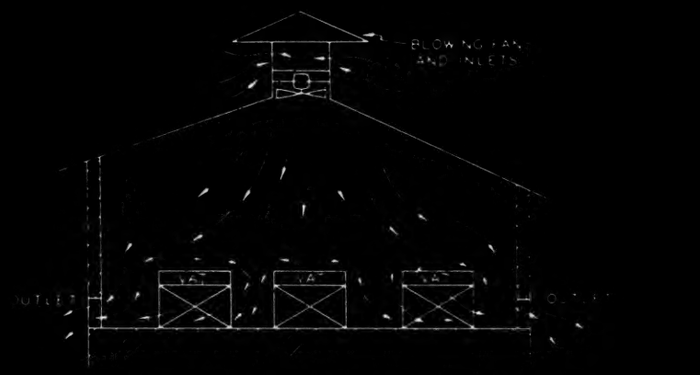


FIG 3 - DILUTION SYSTEM FOR HEAVIER-THAN-AIR NON-TOXIC FUMES. OUTLETS MUST BE KEPT LOW TO PREVENT HIGH FUME CONCENTRATIONS.

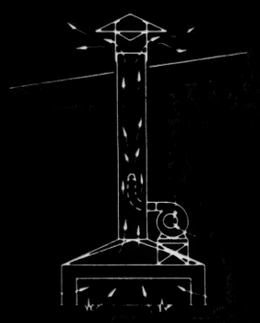


FIG 6 - STRAIGHT TUBE EJECTOR USING A PRIMARY BLOWER.

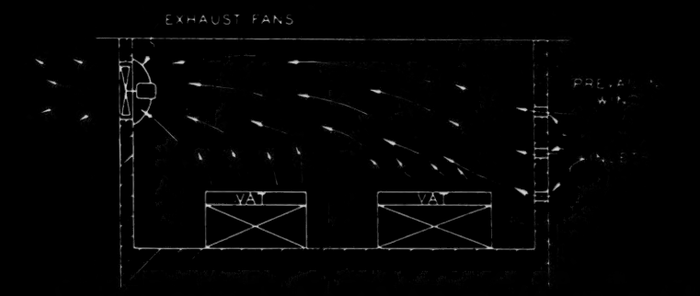


FIG 4 - DILUTION SYSTEM USING PREVAILING WIND DIRECTION FOR BETTER CONTROL OF LIGHTER-THAN-AIR FUMES.

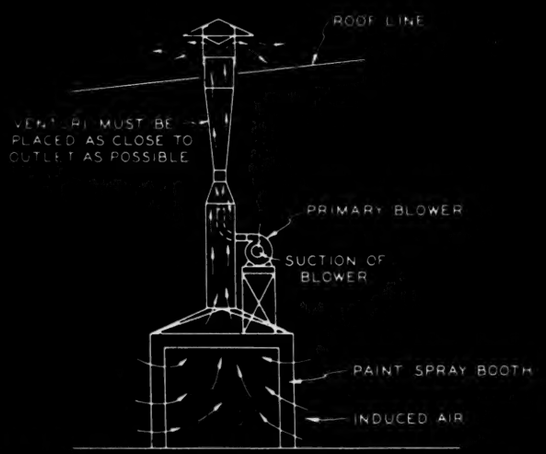


FIG 7 - ILLUSTRATING VENTURI EJECTOR SYSTEM OPERATED WITH PRIMARY BLOWER.

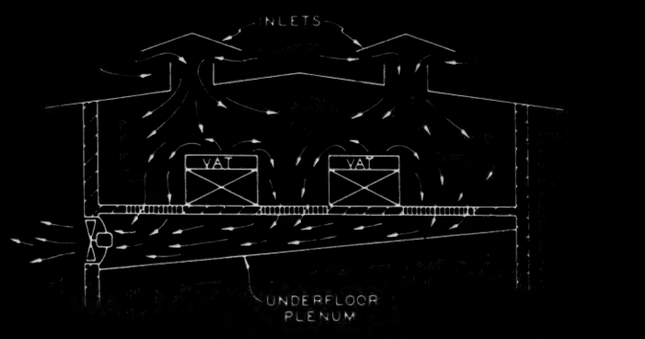


FIG 5 - DOWNDRAFT DILUTION SYSTEM FOR HEAVIER-THAN-AIR FUMES UTILIZING GRATINGS AND EXHAUSTER DUCT.

sary to exhaust more air than would normally be drawn in these machines operating. However, this condition can be considerably mitigated by using certain design types. Whether these types are warranted by the economic factors involved, we shall attempt to help the reader decide.

TYPE OF SYSTEM

Based on the analysis described previously, there will be one or more types of exhaust or ventilation systems which will be the better fitted to meet the problem and the conditions at hand. In order that the reader may make an intelligent choice, the general characteristics of the various types of systems will be described.

a. Natural Draft

One of the simplest types of systems used in industrial exhaust ventilation is the natural draft system. In such a system, as shown in Fig. 1, a hood is constructed over the vat, pan, table or other fume producing object. To the hood is connected a vertical stack and a discharge outlet at the roof. Care must be exercised, in such an installation, to design the outlet so that no back drafts will blow down the stack and nullify whatever good the stack might otherwise do. Shown are two types of outlets which prevent back draft. While there are other types, these are the most widely used.

In a system of this type, the static head or pressure causing airflow or gas flow up the stack is caused by the difference in weight of the volumn of gases within the stack and a column of air the same height. Hence, it is apparent that a system of this type functions only when the density of the gas within the stack is less than the density of the surrounding air. The lower the density of the gas, the more satisfactorily will the system function. (Such a system is valueless for the removal of dust unless the dust is microscopic in size and surrounded by heated air or some other lighter-than-air medium.)

Since air flows through a stack by virtue of a difference in air density between the source being controlled and the surrounding air, this difference can be related to temperature, and the volume of flow computed by means of the following formula

$$Q = AV = 8.02\ A \sqrt{\frac{H\ (t - t_o)}{460 + t_o}} \quad (1)$$

where

Q = volume of air flow, cu ft per sec;

A = area of stack, sq ft;

H = height of stack, ft;

t = inside air temperature or temperature within hood located at source to be controlled, F;

t_o = outside air temperature, F.

The area of the stack should be chosen so that the air velocity does not exceed 4 ft per sec.

b. Simple Dilution

The dilution system, equally effective for extremely fine dusts and fumes, gases or vapors, is based on the exhausting from the work area of such a great volume of contaminated air (with its consequent replacement by fresh air) that the rate of production of fumes is relatively low, with a consequent contaminant concentration within safe limits or standards. Where the gases given off are lighter than air, a system such as shown in Fig. 2, utilizing exhausters located in the roof, works very well. Where the gases or fumes are heavier than air, location of the exhausters under the floor, if done without any great expense, will provide an effective exhausting arrangement. However, due to the miscibility of gases, it is unwise to go to extremes to obtain downdraft exhaust in a simple dilution system. The main feature of this system is *dilution*, not airflow control. The rate of fume or gas production should be calculated (with the help of a chemist, if necessary) and enough air should be circulated to dilute the contaminating mixture down to safe limits.[2] In some cases it may prove more effective to locate the fans in the ceiling or roof and use them as blowers, rather than exhausters. In this case, outlets to the atmosphere should be provided close to the floor as shown in Fig. 3. Variations of this type for reasons of room or fixture arrangement or to make efficient use of a prevailing wind are illustrated in Figs. 4 and 5. Since such systems, in general, rely on the circulation of relatively large volumes of air for effectiveness, *the cost of equipment grows excessive where other than small quantities of fumes or other contaminants are produced.* The simple dilution system cannot be used economically and effectively for exhausting large quantities of fumes or gases under conditions involving high rates of production. Local exhaust systems must be utilized.

c. Venturi Ejector

Occasionally in exhaust design it is desired to exhaust corrosive vapors or mists, hot gases, or materials which on coming into contact with the blades of a fan would condense and stick there, thus reducing the efficiency of the fan considerably and perhaps making it inoperative due to unbalance or other reasons. In such cases, it is desirable mechanically to exhaust the entrained material without passing it through a fan. One such system, called the venturi ejector system, is illustrated in Fig. 6 while another variation of the same type is shown in Fig. 7. In Fig. 6, a hood surrounding an operation, such as paint spraying, is being exhausted. Close to the outlet to the roof the discharge piece is replaced by the venturi tube. A small blower handling room air discharges a high velocity stream or jet into the center of the venturi tube in the direction of exhaust flow and shortly in front of the converging section. (See Fig. 12 for proper proportions of venturi ejector.) The impact of the high velocity air on the relatively slow moving air in the tube causes an increase in velocity of the slow moving air with a subsequent decrease in velocity of the jet air. The result is ejection of the entire mixture at the discharge. Due to the rarefaction of the air in the tube shortly before the mixing chamber (on the upstream side) a negative pressure or suction is set up, inducing flow through the entire system up to the mixing chamber.

Such a system should be designed so that resistance to flow in both the primary jet tube and the exhausting set-up itself is reduced to a minimum. Any unnecessary resistance will materially reduce the amount of air induced. In every case, the ejector unit (the venturi) should be placed at the tail end of the system. Such a system will not function against any but the slightest resistance on the discharge side of the ejector, while, if necessary, an appreciable resistance can be worked against on the suction side. For such a system to function satisfactorily, it is necessary that the primary jet velocity be of a high order, hence the need for a primary blower capable of developing the necessary pressure. All of the pressure (with the exception of a small amount of duct friction) will be due to the conversion of the relatively low velocity blower discharge air to very high velocity jet air, in the final cone. Following is a performance formula developed by the writer[3] which, when used with the chart in Fig. 13 for values of the constant K and a venturi ejector such as proportioned in Fig. 12, can be used in the design of venturi ejector systems:

$$SP = \left(\frac{CFM_1 + CFM_2}{A}\right) \times$$

[2] See "Economical Dust Control with Low Resistance Exhaust Systems, by the author, HEATING AND VENTILATING, October, 1940.

[3] See HEATING AND VENTILATING, June and August, 1940.

VARIOUS TYPES OF EXHAUST VENTILATING SYSTEMS

ALSO SEE FIGS. 1-7, INCL.

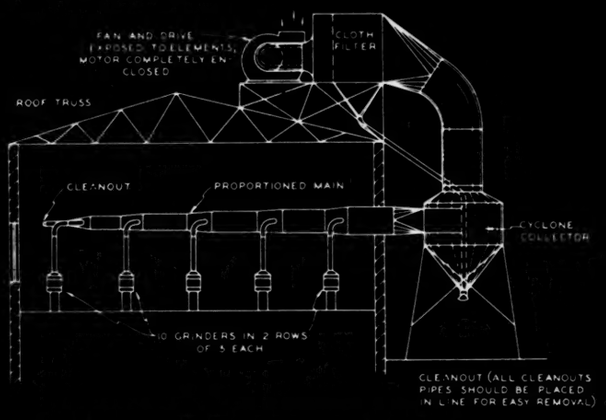

FAN AND DRIVE EXPOSED TO ELEMENTS; MOTOR COMPLETELY ENCLOSED
CLOTH FILTER
ROOF TRUSS
CLEANOUT
PROPORTIONED MAIN
CYCLONE COLLECTOR
10 GRINDERS IN 2 ROWS OF 5 EACH
CLEANOUT (ALL CLEANOUTS PIPES SHOULD BE PLACED IN LINE FOR EASY REMOVAL)

FIG 6 - GRADUATED OR PROPORTIONED MAIN SYSTEM. CROSS-SECTIONAL AREA OF MAIN AT ANY POINT MUST BE AT LEAST EQUAL TO SUM OF BRANCHES UP TO THAT POINT

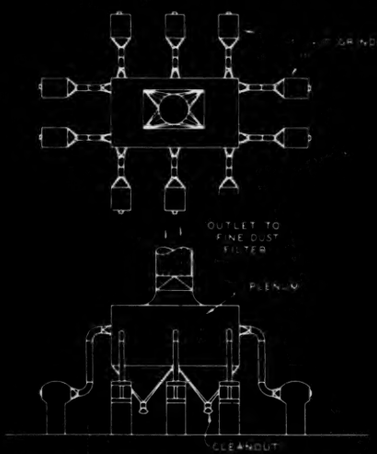


FIG 9 - CENTRALLY LOCATED OVERHEAD PLENUM

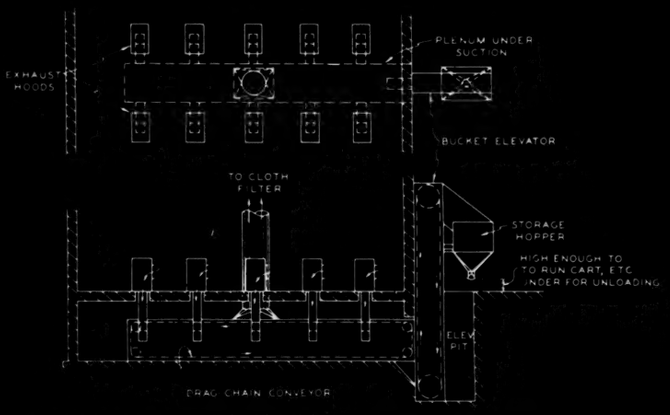


FIG 10 - PLENUM EXHAUST SYSTEM ADAPTED FOR USE UNDER HOODS

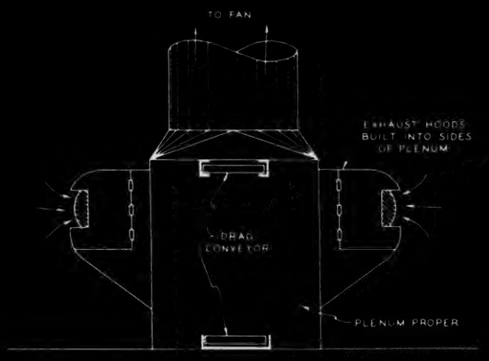


FIG 11 - PLENUM SYSTEM WITH BUILT-IN HOODS AND DRAG CONVEYOR

$$\left[\frac{\left(\frac{CFM_1 + CFM_2}{A_d}\right)K - 2V_j}{(4006)^2}\right]$$

where SP = static pressure produced by jet (negative pressure or suction) and available for overcoming resistance to flow up to mixing chamber, in inches water gauge;

CFM_1 = Cubic feet per minute of flow induced into system;

CFM_2 = Cubic feet per minute blown into ejector by jet blower;

A_d = Cross-sectional area of ejector discharge or inlet in square feet;

K = Constant (see Fig. 13); and

V_j = Velocity at jet discharge, in feet per minute.

$$BHP = \frac{CFM_2 \times VP_j}{.6356\ E}$$

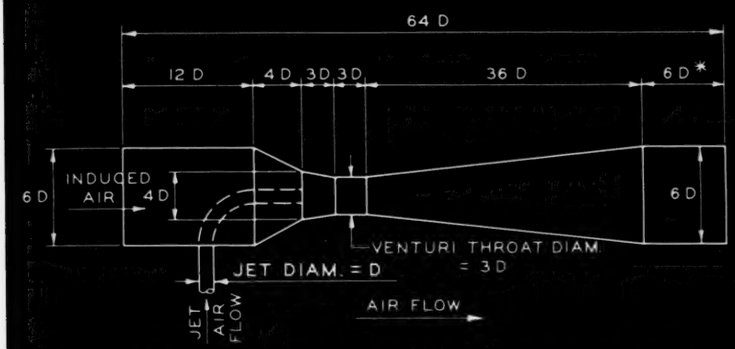
While with careful design, it is possible to secure efficiencies as high as 25% (ratio of induced air-horsepower to jet air-horsepower), the average installation has an efficiency usually not exceeding 15%. One of the characteristics of this type of system is that with proper proportioning an induced air volume up to six times the jet air volume may be obtained. Thus, in cases where great volumes must be mechanically exhausted, and where the operation is intermittent, a venturi system may be a very desirable substitute for the usual type of system and will probably represent an initial investment in equipment of about one-third.

Waste gases liberated as by-products and under a pressure of more than 1 lb per sq in. may be utilized in the same fashion as described for air with approximately the same results. Steam, being expensive, is limited in its application, as is water; however, results using steam are quite satisfactory. Below are given some performance data for a commercial type of steam-jet exhauster. This is based on the use of steam at a pressure of 60 lb per sq in. and with a static pressure development on the upstream side of the mixing chamber of as high as 2 inches water gauge.

Steam Pipe Dia., In.	Air Capacity, Cfm	Air Inlet Dia., In.	Air Disch. Dia., In.
⅜	166	4	3
½	333	5	4
½	500	8	5
¾	750	9	6
¾	1000	11	7
¾	1500	12	8
1	2000	14	10
1	3000	16	12
1¼	4000	18	14
1½	8333	24	18
2	16677	32	24
2½	33333	42	32

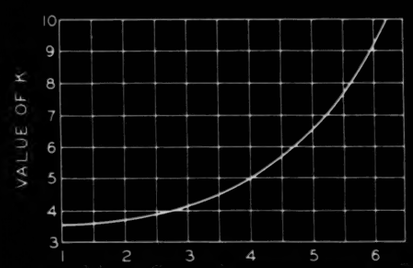
EJECTOR DESIGN

FIG. 12 – DIMENSIONS OF VENTURI EJECTOR



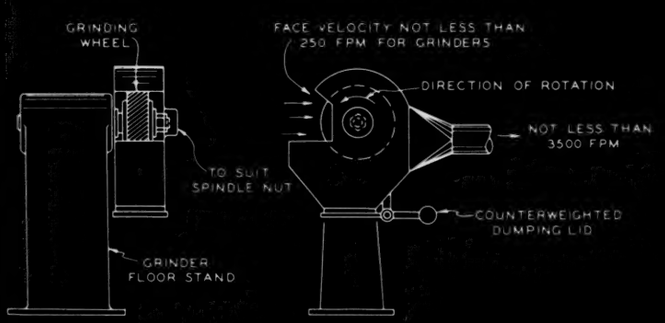
* FOR GOOD RESULTS, THIS DIMENSION SHOULD NOT EXCEED 6 D. A SHARP DROP IN INDUCED AIR VOLUME RESULTS WITH INCREASED PIPE LENGTH (AND RESISTANCE) AT THE VENTURI OUTLET

FIG. 13 – CHART FOR DETERMINING VALUE OF K. THIS VALUE IS TO BE INSERTED IN EJECTOR PERFORMANCE FORMULA.



RATIO $\frac{D'}{D}$ = $\frac{\text{VENTURI DISCHARGE DIAM.}}{\text{JET DISCHARGE DIAM.}}$

GRINDER HOODS


GRINDING WHEEL
FACE VELOCITY NOT LESS THAN 250 FPM FOR GRINDERS
DIRECTION OF ROTATION
NOT LESS THAN 3500 FPM
TO SUIT SPINDLE NUT
COUNTERWEIGHTED DUMPING LID
GRINDER FLOOR STAND

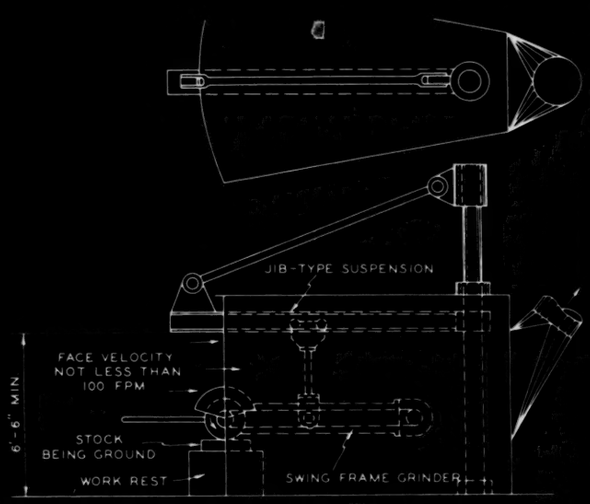
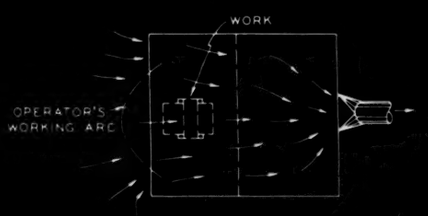
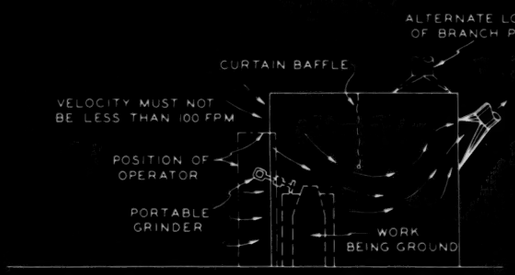
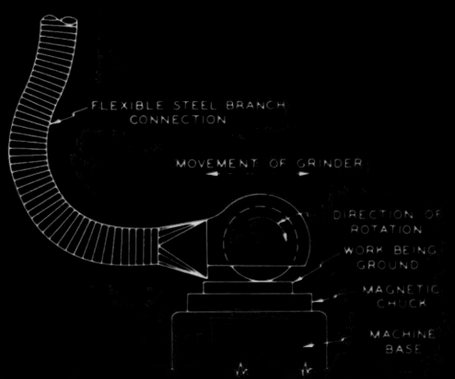


FIG. 14 – (UPPER LEFT) FLOOR STAND GRINDER EXHAUST HOOD
FIG. 15 – (UPPER RIGHT) SWING FRAME GRINDER HOOD, ENCLOSURE TYPE
FIG. 16 – (LOWER LEFT) PORTABLE GRINDER HOOD, ENCLOSURE TYPE
FIG. 17 – (LOWER RIGHT) SURFACE GRINDER EXHAUST HOOD







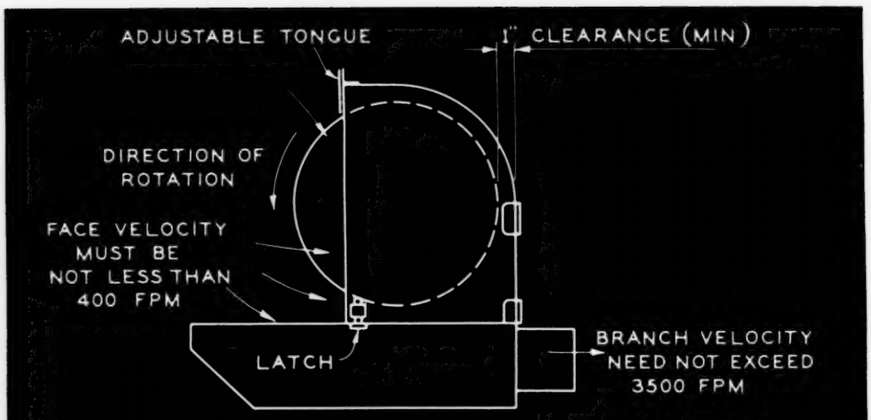

ADJUSTABLE TONGUE
1" CLEARANCE (MIN)
DIRECTION OF ROTATION
FACE VELOCITY MUST BE NOT LESS THAN 400 FPM
LATCH
BRANCH VELOCITY NEED NOT EXCEED 3500 FPM

FIG. 18 - TYPICAL BUFFER HOOD

d. Proportioned Main Exhaust

This type of exhaust system, the most prevalent of all, is illustrated in Fig. 8. It consists essentially of hoods, branch and main piping, traps, a cyclone or other preliminary cleaner, and/or cloth filter, and a centrifugal or disc-type exhauster and driving motor. The piping in such a system is usually proportioned so as to maintain adequate and constant air velocity throughout. In this manner the material may be conveyed between the point of entrainment (the hood) and the point of cleaning or discharge without dropping out of the air stream en route. Whether or not a filter or other cleaner is used depends on the location of the point of discharge and the value or nuisance of the material being discharged. Fumes, if at all dangerous, should be removed from the air at the point of discharge. Air washers and electrostatic precipitators can successfully filter fumes from contaminated air. When the contaminants are not dangerous or otherwise useless, the discharge stack should be high enough so as to be diluted sufficiently by the time they reach breathing height that there will be no noticeable odor, color, or taste.

The essential operation of an exhaust system is as follows: each dust or fume producing operation is hooded (as explained in this article) and provided with a branch pipe under suction so as to exhaust the contaminated air. The volume of air to be exhausted in each case is determined by the hood opening and the air velocity at the hood opening necessary to control the nuisance (keep dusts or fumes from escaping into the workroom air from the hood). Thus, if the hood has an opening of 2 sq ft and the method of formation of the dust and the type of hood require that a face velocity (at hood opening) of 500 feet per minute be maintained for satisfactory dust control, then the volume of air to be exhausted will equal $2 \times 500 = 1000$ cfm. This determines the volume of air for this branch. If there are 15 branches requiring 1000 cfm each and 5 requiring 1500 cfm each, then the total volume of air that the system will have to handle is equal to $(15 \times 1000) + (5 \times 1500) = 22{,}500$ cfm. Since approximately 10% is usually allowed to cover air leakage throughout the system, the total air volume now becomes 24,750.

The next important step is the determination of the air velocity necessary to convey the material caught. Where both heavy and light materials are entrained at the same time, it is always wise, if possible, to drop out the heavier material in a trap built into the hood or not far from the hood. Thus it will be unnecessary to maintain the extremely high conveying velocities otherwise necessary. Not only is it costly from the standpoint of initial expense to maintain high pipe velocities (resistance to flow throughout system varies as square of velocity, and fan will have to be selected to work against the necessary resistance), but since the horsepower required for daily operation varies directly as the resistance, the power charges will be considerably increased. Again, wear and tear on piping, fittings, etc., are considerably greater with high velocities than is so with low velocities. Hence the need for a pipe velocity sufficiently high to convey the material desired, and very little higher. The following approximate formula suggested by DallaValle may be used in determining the necessary transporting velocity:

$$V = 13{,}000\left(\frac{S}{S+1}\right)\sqrt{P}$$

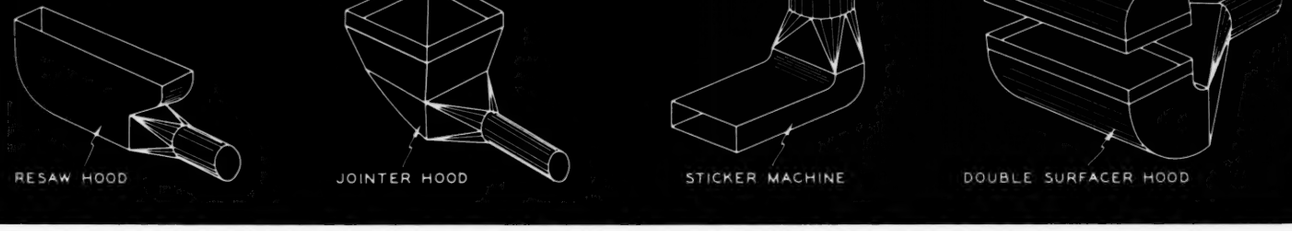
where V = transporting velocity, in feet per minute;
S = specific gravity of the material; and
p = particle diameter, in inches.

Having determined the transporting velocity, the resistance of the longest branch plus the main is determined. The total resistance against which the fan must operate of course includes the resistance of the collector and discharge duct plus the head required to produce the flow.

Fan selection may now be made from convenient rating tables furnished by fan manufacturers. From the system resistance and total air volume, we select a fan, noting its size, speed, and required brake horse-power. Since there will be several types of fans that can meet our requirements care must be used to make a correct selection. Usually, the larger the fan, the slower the speed and the lower the brake horsepower. However, larger

WOODWORKING EXHAUST HOODS

FIG 19 – A FEW OF THE MANY TYPES OF WOODWORKING EXHAUST HOODS



fans are more expensive. Thus it is necessary for the designer to balance operating against initial cost. Besides size, there are three types of centrifugal fans and a number of types of disc or propeller fans suitable for exhausting work from which selection must be made. The types and characteristics of these fans will be explained in the next section.

In an exhaust system, every effort should be made to make the total length of run as short as possible. Even though a satisfactory layout is obtained, effort should be concentrated on attempting to reduce the resistance by substitute layouts until it is certain that the most economical layout has been secured. It goes without saying that fittings, elbows, entry and discharge pieces, weather caps, etc., must all be designed so as to impose an absolute minimum of resistance to flow. While it will be attempted to set forth the most efficient proportions of each of the above pieces, no attempt will be made to cover these points in detail or to go into the theory behind the correct proportioning. (See Component Parts of System.) Cyclone separators, cloth filters, air washers, and electrostatic precipitators should all be carefully studied and the manufacturers consulted so as to secure equipment which not only performs well, but which operates economically and requires a minimum of repair. First cost should be considered, but should not, of itself, determine the type or size unit to be selected.

e. Two or More Systems

As has been explained in the foregoing, excessive resistance causes excessive power requirements. While not so much can be done about it, it is just as true that excessive air volume causes excessive power bills. This is not necessarily due to poor design or estimates on the part of the designer as to inflexibility in the system itself. It is rare indeed that a service for 50 dust or fume producing machines is ever called upon to exhaust fumes or dust simultaneously from all machines. In dust exhaust systems, it is necessary, as previously explained, to maintain the velocity at a certain level so that the material will not be precipitated out. Since, in graduated or proportioned main systems, the piping is designed to maintain a constant transporting velocity, any attempt to close off the air coming from any branch will result in a reduced air volume in the mains and a reduced air velocity—and settling.

f. Plenum Chamber System

Wherever a conventional exhaust system utilizing branch and main piping, filters, etc., is designed consideral thought should be given the possibility of using the plenum chamber system. This system, illustrated in Figs. 9, 10 and 11, not only possess-

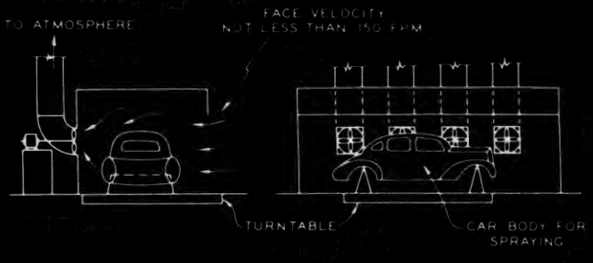


FIG. 20 - ONE TYPE OF AUTOMOBILE PAINT SPRAY BOOTH

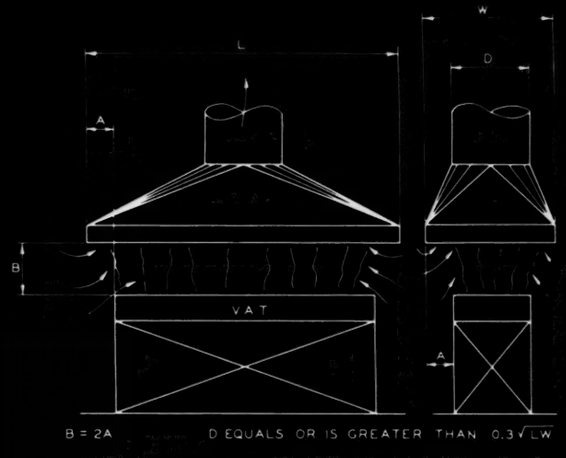


FIG. 21 - OVERHEAD TYPE OF FUME HOOD

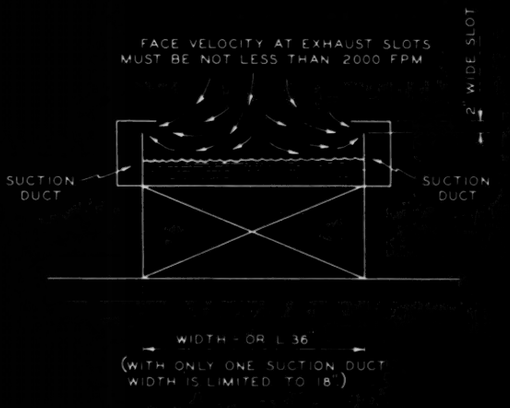

FACE VELOCITY AT EXHAUST SLOTS MUST BE NOT LESS THAN 2000 FPM
2" WIDE SLOT
SUCTION DUCT
SUCTION DUCT
WIDTH = OR L 36"
(WITH ONLY ONE SUCTION DUCT WIDTH IS LIMITED TO 18")

FIG. 22 - LATERAL EXHAUST HOOD FOR HEAVY FUMES

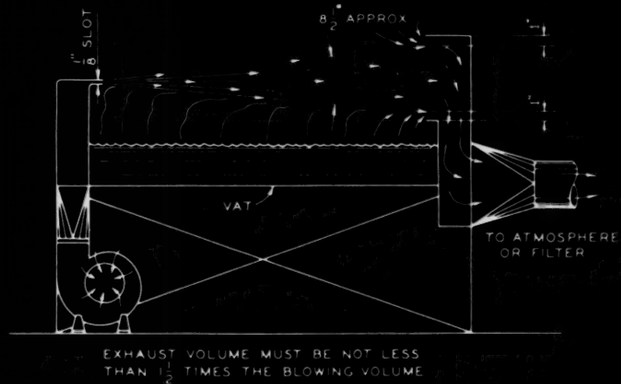


FIG. 23 - SUCTION PRESSURE EXHAUST HOOD FOR FUME CONTROL IN WIDE VATS

es complete flexibility as regards ability to operate under partial as well as full loads but has the added feature, distinctly lacking in the graduated or proportioned main system, of requiring an absolute minimum of balancing of flow between branches. By the very nature of the construction, an almost constant suction, or negative pressure, exists at all parts of the plenum chamber, making it totally unnecessary to introduce throttling devices to prevent those branches closest to the fan from "hogging" the most air. Since such a system endeavors to drop out of the air stream, shortly after entrainment, everything except the "fines," any conveying done from the plenum chamber to the final filter may be done at a considerably reduced velocity, the velocity necessary to sustain the fines in the air stream. This results in a decided saving in resistance with subsequent reduction in power necessary for operation. Again, since in such a system velocities are reduced over a major portion of the system length, wear is minimized with resultant longer life and reduction in maintenance costs. However, since plenum systems vary themselves in type and characteristics, it is difficult to make generalized statements beyond what has already been made. Examining the type of system illustrated in Fig. 9, we note that the plenum is centrally located. *Plenum systems to be of any value must be centrally located.* The advantages of locating the plenum above the machines are usually ease of installation, facility in emptying, and availability for maintenance work. The chief advantage—and this is an important advantage — of locating the plenum under the machines being exhausted is that gravity may be used to convey the heavier material from the hoods to the plenum and a minimum velocity (usually determined by economical limits in pipe sizing) may be maintained in the branch piping connecting these parts to the system. Thus the greatest single contributing factor to the high resistance of an exhaust system can be reduced drastically with resultant slashing of power costs. An ideal arrangement, limited, of course, by existing arrangements of machinery, etc., is to have the plenum located on the lowest accessible floor with branch pipes running up through the floors to machinery located on the floors above. Where no coarse material is being formed, the plenum may be the cloth filter, air washer or connection to electrostatic precipitator used as the fines collector. However, to fulfill the true functions of a plenum chamber, there must be a relatively low velocity pressure with resultant equality or constancy of static pressure at all points within the plenum. In order to obtain this, the chamber must be large enough to handle the required volume at a velocity not exceeding 1000 ft per min as a maximum. By careful design, this may be obtained without prohibitive size. Locating the exhaust from the plenum centrally and locating the plenum centrally with respect to the branches will result in a minimum of unidirectional velocity within the plenum. Where, for some reason, a centrally-located exhaust cannot be attached, then two exhausts, equally spaced, and located so that minimum velocities within box will result, should be incorporated. It is decidedly poor practice to locate one exhaust in a position so much off-center that high velocities result at some part of the box.

The type of plenum chamber system illustrated in Fig. 10 is best suited to long rows of machinery, the length of the plenum matching the longest dimension of the machine layout. Since the width of the plenum in this case is limited by the most efficient dimension as regards feeding the mechanical conveyor in the bottom of the box, the number of rows of machines which can be attached to the plenum is again limited by the angle of flow necessary for the material to descend a chute. Thus for an extremely wide layout of machinery more than one plenum would be necessary. The question may be asked as to the advantage in substituting a mechanical conveyor for a pneumatic conveyor. The answer lies in the relative efficiencies of both, the mechanical conveyor being at least five times as efficient as an air system primarily designed for conveying. Since the exhaust system is not primarily designed for conveying but for the exhausting of contaminated air, its efficiency as a conveyor is rather low.

Fig. 11 illustrates still another type of plenum chamber system. This type, since it requires no branch pipes with its entry pieces, elbows, etc., imposes an absolute minimum of system resistance. Wherever such a type can possibly be incorporated, the savings effected will be phenomenal. Not only is the initial expense of equipment less, but operating expenses are almost negligible by comparison with the ordinary system.

g. Combinations

Very often within a large workroom laid out for most efficient production, it may be advisable to use a proportioned main system for some scattered machinery and a plenum system for machines grouped together. Again, within the room there may be a few processes which can operate satisfactorily on natural draft and a number which must not be passed through a fan but should be eliminated by the venturi ejector. No hesitancy should be shown in combining a number of different type systems. The important thing is to exhaust the room as a whole most efficiently and economically. On occasion, a plenum chamber system may be used for all but two or three machines in a room with many. Rather than provide a separate system for these left-overs which are too far away to be included in the regular manner, they should be connected to a common fan which should then blow the contaminated air to the plenum chamber acting as a booster. From that point on the air is handled by the plenum system. However, in the computations for the total air volume to be handled by the main fan (for the plenum chamber system) not only must allowance be made for all the machines exhausted directly by the plenum but for those which are boosted in order to reach the plenum.

COMPONENT PARTS OF SYSTEM

The most important single part in the make-up of an exhaust system—from the standpoint of dust control—is the exhaust hood. It is also the most difficult for which to set forth performance data. There are so many associated factors which enter the problem of hood design which can only be determined in the field that the writer hesitates to do other than set forth general information supplemented by distinct hood types with proved performance data.

a. Hoods

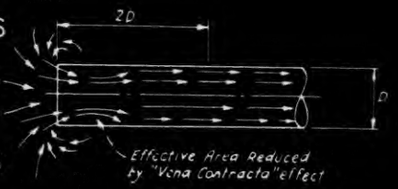
In hood design certain fundamentals must be observed. Here they are: The first, the most important, and the simplest rules — although not the easiest to comply with — is enclose the dust or fume producing operation as completely as practicable. Only as a last resort should any hood be designed in which the operator or any associated worker must work within. Where this must be done, every effort should be made to cause the fresh air entering the hood to go from the operator to the dust or fume generating source — not vice versa. Rule number two—also simple, but important — is design the hood so that any inherent velocity which may be existent in the dust or fume formed is utilized to help entrain itself within the hood and not, as so often is the case, depend on an excessive hood face velocity to capture material which has a natural tendency to escape the hood. Boiled down, this means locate the hood opening where the material being created cannot readily be thrown out. For example, in the case of wax, sulfur, lead and other pots in which the tendency is for the fumes to be given off in a vertical direction, ar-

FITTING RESISTANCE

(A) TO (H) HOODS BRANCHES
(I) AND (J) FILTER CONNECT.
(K) FAN OUTLET CONNECT.
(L) TO (N) JUNCTION TYPES

NOTE 1. Area at face of hood at least 10 times area of "D."

NOTE 2. Hood face area approx. 6 times branch pipe area "D."

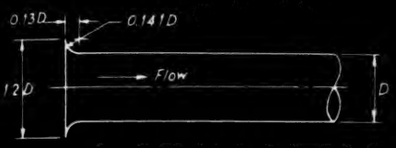


Orifice Loss (back to 2D) = 87% V.P.

(A) Pipe without Hood

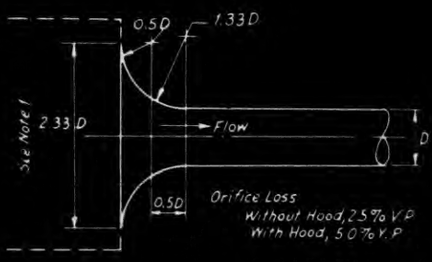
Orifice Loss = 47% V.P.

(B) Hood and Branch Connection



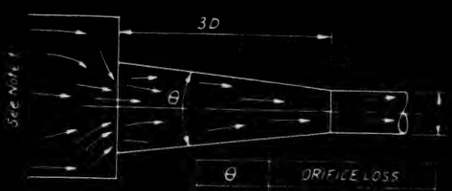
Orifice Loss = 15% V.P.

(C) Pipe with "Bell Mouth"



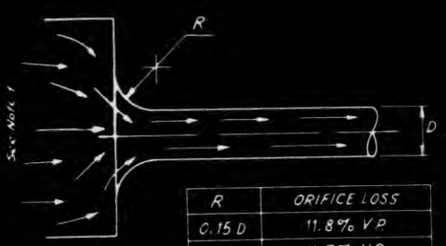
Orifice Loss
Without Hood, 25% V.P.
With Hood, 5.0% V.P.

(D) U.S. Bureau of Standards Nozzle with Vena Contracta practically eliminated



θ	ORIFICE LOSS
5°	12.0% V.P.
10°	11.3%
13°	11.0%
15°	11.3%
20°	11.7%
25°	12.0%
30°	25.0%

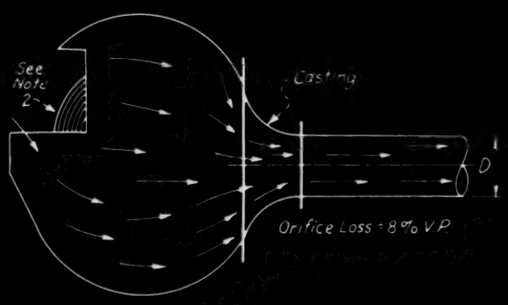
(E) Hoods with Converging Cones of Various Included Angles



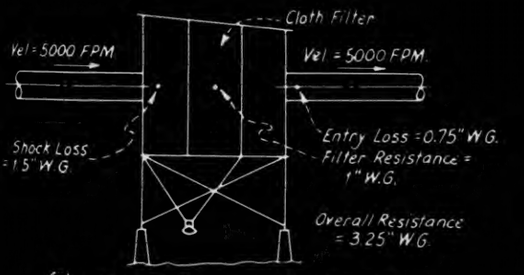
R	ORIFICE LOSS
0.15 D	11.8% V.P.
0.25 D	11.7% V.P.
0.50 D	10.8% V.P.
0.75 D	10.4% V.P.
1.00 D	10.3% V.P.
1.25 D	10.2% V.P.

(F) Hoods with Bell Mouths of Various Radii

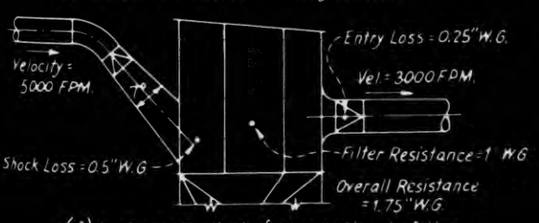
(G) Typical Grinder Exhaust Hood



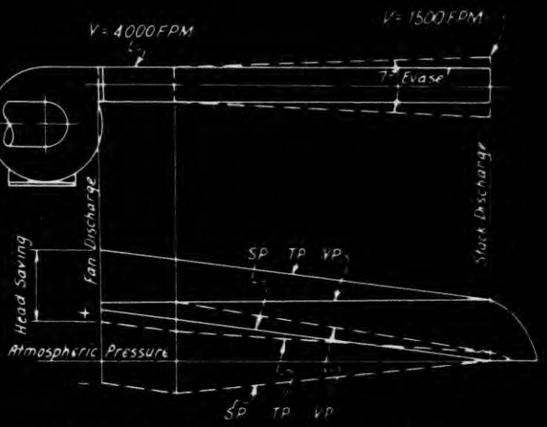
(H) Grinder Exhaust Hood using adaptation of U.S. Bureau of Standards Nozzle



(I) Improper method of connecting to filter



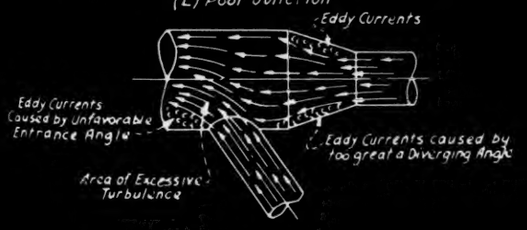
(J) Preferred method of connecting to filter



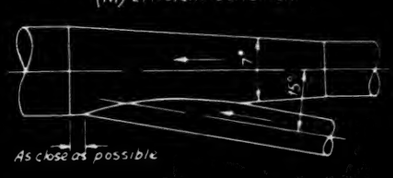
(K) Effect of diverging stack on total pressure or resistance

Data from "Industrial Dust" by Drinker and Hatch; "Air Conditioning and Engineering"; American Blower Co.; "Fan Engineering", Buffalo Forge Co.; and publications of Amer. Foundrymen's Assoc. and University of Illinois.

(L) Poor Junction


Eddy Currents
Eddy Currents Caused by Unfavorable Entrance Angle
Eddy Currents caused by too great a Diverging Angle
Area of Excessive Turbulence

(M) Efficient Junction



(N) Efficient Rectangular Junction

FIG. 24

range the hood so that the branch pipe is at the top or very near the top. Place the face opening as near the bottom of the hood as possible. In the case of grinders such as illustrated in Fig. 14, there are a number of complicated conditions existent which experience has shown can best be met with a hood as shown. Due to action of the wheel against the work, there is a tendency for a stream of chips with attendant dust particles to be generated and to leave the point of contact in a line tangent to the wheel and in the same instantaneous direction. The chips impinge on the first fixed object in its path and then bounce. Thus, the surface of the hood on which the chips will impinge should be sloped so that the chips will be thrown or will bounce in the direction of the exhausting pipe, if this is desired. Since there are always fine dust particles which are induced to follow the larger chips, due to the suction created immediately behind the chips, catching the chips insures catching a good part of the dust. Again, due to the fan action of the wheel a high velocity stream of air is generated which is rotational in direction, following the wheel and proportional to its speed. Close examination reveals that fine dust is caught in this stream and largely maintained there unless broken up or deflected by a plate or a correctly located exhaust pipe. If the exhaust pipe is located tangentially, not to the wheel, but to the air stream around the wheel (which may be 1 to 2 inches from the wheel periphery) and not too far away from it, the chances of capturing this dust is excellent. Due to wheel wear, an average condition of size must be designed for. Also because of the motions of the operator, it may be necessary to make the hood more open than would be ordinarily desired. For purposes of accumulated heavy chip removal, change of worn wheel, etc., doors are necessarily included as part of the hood. Since a hood should be designed as a permanent fixture and not something to be taken off when it is "in the road," it should be substantial and of heavy steel plate rather than light gauge sheet iron. Because of these foregoing reasons, some of the theoretical suggestions or rules may have to be relaxed somewhat. Then, in order to compensate for what is now "inefficiency" in the hood, the hood face velocity should be increased above the minimum, as well as the hood air volume. Average hoods of this type operate very satisfactorily on a face velocity of about 400 fpm. However, the nature of the work done, the amount of material removed or produced, the movements of the operator and other points already described may necessitate an increase or allow a decrease from this amount. Swing frame grinders, portable grinders, surface grinders, belt grinders and polishers, buffers, various wood-working machines, paint-spray booths, and various fume-producing operations are shown hooded in Figs. 14 to 17 and 20 to 23. Hood face velocities, for average conditions, are given with each hood type. These are to be used as a guide only. Individual conditions will alter these upwards or downwards.

While fume or vapor producing operations are usually not so hard to control as dust producing machines, they must nevertheless be carefully analyzed in order to secure good fume collection without the handling of too great a volume of air. In general, fume collection may be handled in two ways—overhead and lateral exhaust (Figs. 21-23). The overhead exhaust shown in Fig. 21 is best suited for volatile fumes or vapors which, being lighter than air, have a normal tendency to rise and hence are easily collected. As explained before, hooding or enclosure should be as complete as possible. Where, however, a side cannot be closed, the hood should lap that side, the degree of lap being approximately 25% of the opening height. With small tanks, economical as well as good collecting efficiency may be accomplished by means of lateral exhaust as illustrated and dimensioned in Fig. 22. However, due to the inherent tendency of air under suction to pull from all directions equally unless inhibited by baffles, etc. (which are only partially effective), any attempt to draw fumes too great a distance laterally will meet with failure. Lateral hoods are usually designed with slots about 2 inches wide. The air volumes are based on the following requirements: 100 cfm per sq ft of tank area for slots on two sides and 120 cfm for a single slot. The duct under suction will draw well up to about 18 inches; thus a 36-inch wide tank would need a suction duct along each side of this dimension. The bottom of the slot should be about 6 inches above the level of the liquid in the tank.

When the normal flow of air into a hood is unobstructed, the velocity at any point along the axis may be obtained from the following formula:

$$V = \frac{0.1Q}{x^2 + 0.1A}$$

where V = the velocity at the point in question, in feet per minute;
Q = volume of air handled by hood, in cubic feet per minute;
A = the area of opening in square feet; and
x = the distance along the axis, in feet.

In the combined pressure-exhaust hood illustrated in Fig. 23 it is not attempted to sweep the fumes across the hood directly, but rather the result is obtained by locating the blowing slot well above the liquid level and making the stream of air a high velocity curtain so that fumes given off which touch this curtain will be deflected in the direction of the suction duct. The velocity of the air issuing from the blowing duct is dependent on the width of the vat or tank; that is, the wider the tank the higher the velocity to obtain good control. The velocity at any point along the blowing axis may be approximately obtained from the following formula:

$$V = \frac{Q}{(.14x + W)L}$$

where V = velocity at any point along blowing axis, fpm;
Q = blowing volume, cfm;
x = distance of point in question from duct, in feet;
L = length of blowing duct, in feet; and
W = width of blowing duct, in feet.

Since it is desired to keep the air volume as low as possible while maintaining an adequate control velocity, the blowing slot width should not exceed ⅛ inch. The blowing velocity should not be less than 1000 per foot of tank width; thus a 6 foot wide tank would require a blowing velocity of 6000 fpm. While this may seem high, the resultant velocity due only to this blowing stream (neglecting the air induced due to the suction duct) at a point adjacent to the suction duct (all the way across the tank) is approximately 75 fpm. Hence, for extremely dangerous fumes even higher velocities should be used to insure safety.

b. Branch and Main Piping

Piping for exhaust systems is generally made of light gauge sheet steel, either unpainted black, galvanized, or stainless. For certain corrosive fumes it is necessary to resort to specially lined ducts or certain alloy steels. For instance, nitrous gases, chlorine, and hydrochloric acid are best handled with nickel-chrome alloy steels, while hydrogen-sulphide, sulphurous gases, etc., necessitate a high nickel-chrome alloy steel for adequate resistance to corrosion. As alternatives, chlorine and hydrochloric acid can be successfully handled with rubber-lined steel (or other) piping, while hydrogen-sulphide can also be handled with aluminum coated iron. Ammonia is best handled with iron or steel ducts. Certain other fumes necessitate wood ducts. Where corrosive fumes other than those mentioned are to be conveyed, either a chemist or other competent consultant should be referred to for proper specification. Usually a plant's own maintenance personnel will be best fitted to specify the material to be used due to experience with the fume in question.

Where fumes or non-abrasive dusts are to be handled, the gauge thickness of the duct material need only be a function of the duct diameter. That is, the greater the diameter, the thicker

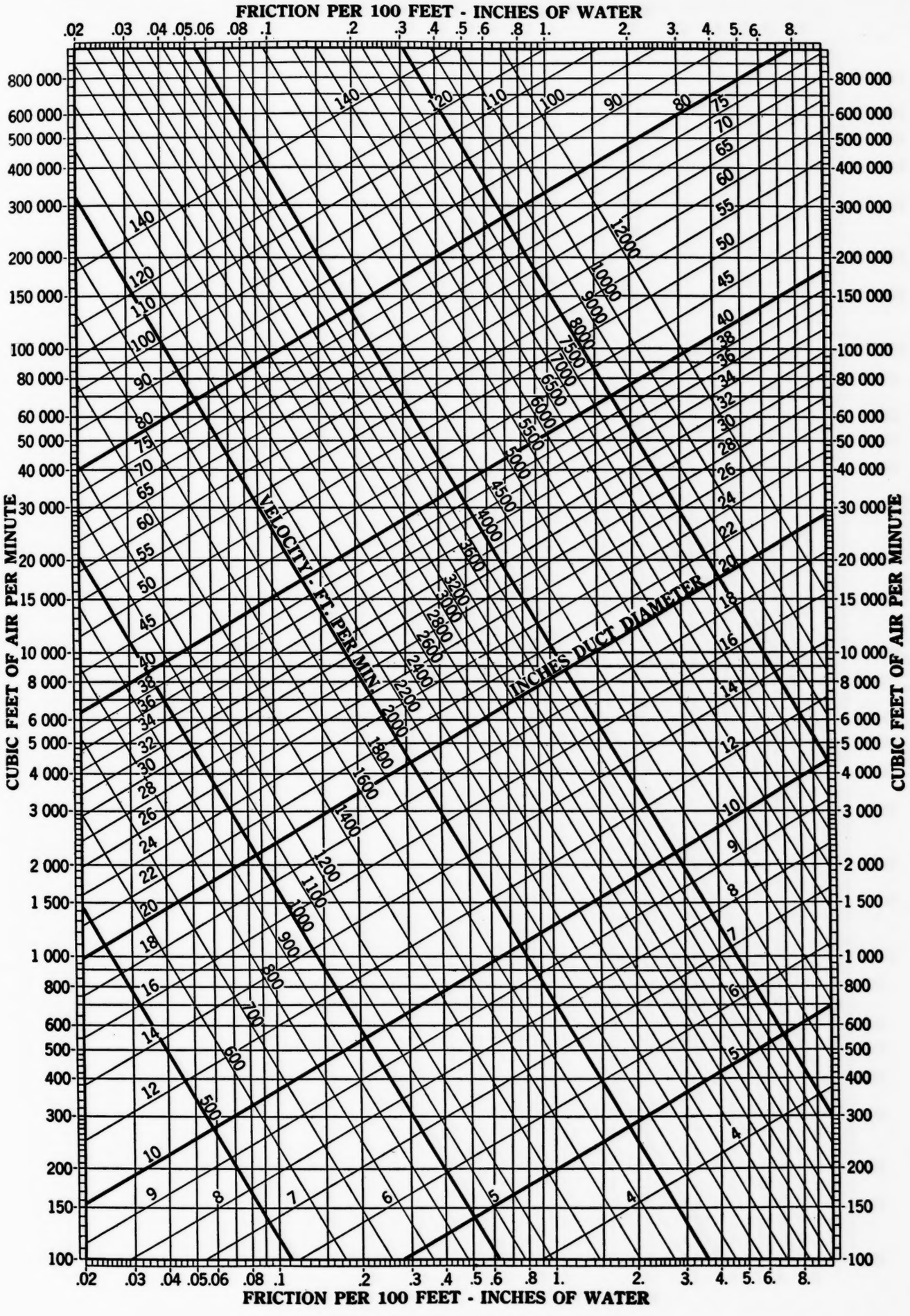


Fig. 24a. Friction chart for duct sizing.

the material. This is necessary for adequate structural strength. In general, the following data may be used for ducts of various sizes:

Up to 8 in., incl—24 gauge.
Over 8 to 18 in., incl—22 ga.
Over 18 to 30 in., incl—20 ga.
Over 30 in.—18 ga.

Sheet metal elbows should be made about two gages heavier than the ducts to which they are connected. Also, since rectangular ductwork does not have the structural strength and rigidity of round piping, it should be made at least two gauges heavier for the same air volume handled. Also, use should be made of cross-breaking, flanging, and, on occasion, struts in order to maintain adequate rigidity. Where extremely high suctions are necessary, as in long runs (where suction exceeds 8 inches water gauge), both round and rectangular piping should be made of heavier gauge while rectangular piping may need additional stiffening. Since such suctions are encountered almost solely in heavier material conveying and such conveying will require heavier pipe in any event for resistance to wear, suction requirements are rarely considered in fume handling as regards duct material thickness. Where abrasive material is conveyed, much heavier duct material is necessary for even a medium life, especially at the elbows. Since many elbows in hard service may last no more than two weeks, initial economy may not prove wise. Cast iron or steel water pipe of the long radius pattern has proved ideally suited for extremely abrasive service. Since the cost of incorporating such an elbow (despite its great increased weight) into the system design will increase the cost of the entire system no more than from 2% to 5% the use of such elbows should be considered.

While it is usually sufficient to rivet and solder elbows and seam straight piping, riveting only the larger sizes, in many cases for reasons of great vibration, frequent take-downs, increased structural strength, etc., welded piping is preferable. Where welded piping is used, the individual sheet lengths should be joined into 10- to 15-foot lengths and flanged for easy installation and easier repair. Since welding is best done with black iron or stainless steel, this is a factor to be considered where galvanized iron is desired. Galvanized iron may be welded but the weld must then be painted, the resultant job not being as neat as might otherwise be the case.

Regarding correct pipe diameters, this is determined by the volume of air which the hood must handle in order to control the dust or fume, and the transporting velocity necessary. Where only fumes are conveyed, pipe velocities may be as low as 3000 fpm thus keeping the pipe resistance down to a reasonably low figure. Lower velocities will necessitate larger piping with subsequently heavier supports, etc., increasing the cost all the way along the line. Where material is being conveyed, the transporting velocity should be determined as previously outlined. The only other important factor yet unconsidered is "balancing" of the various branches. This is the inclusion in the design of the exhaust system of means of equalizing the overall resistance to the flow of air of each airflow route. In a system of ten hooded machines, some of these machines are bound to be nearer to the source of suction, the fan inlet, than the others. These machines, all other considerations being equal, would offer less resistance to the flow of air than would the machines at a greater distance from the fan. Hence, a greater than proportional share of the air volume handled would come from these nearer machines or hoods. By the same token, a number of machines all located about the same distance from the source of suction, but handling different volumes of air at a "supposedly" equal velocity would in reality be unbalanced. This is due to the fact that smaller diameter piping offers more resistance to the flow of air—at the same velocity—than does larger diameter piping. The result is that the smaller diameter pipes handle less air (due to the larger pipes handling more air than their share), the pipe velocity drops, and unsatisfactory performance may result.

In figuring resistances in systems of more than one branch, the branch presumably farthest from the fan should determine the maximum resistance the fan must work against. Resistance should be figured first on the basis of the desired hood volumes and the proper air velocities throughout (including allowances for all pipe, fittings, hoods, filters, connections, discharges, etc.) Then, using the maximum resistance as a criterion, every other branch resistance should be increased up to the same value by the simple expedient of decreasing the pipe diameter while maintaining the desired air volume. Thus, not only is the resistance increased due to the smaller pipe diameter but also to the increased pipe velocity. Care should be exercised, however, to see that a single branch of relatively low volume but high resistance does not necessitate a general increase in resistance up to its level. Air horsepower is the product of the air volume and the resistance to flow (approximately). Let us suppose that a branch representing no more than 1.5% of the total air volume has a resistance 20% higher than the remaining branches. Certainly it is poor economy to raise the remaining 98.5% of the air volume 20% so that this branch which is farthest from the fan may get its desired share of air. The proper procedure in such an instance is to increase the diameter of the branch pipe in question until its resistance to flow matches any other branch entering at the same section of the main duct. In other words, the static pressure at the point of entrance to the main should be designed so as to be the same for the main and the branch. Thus, the increase in air volume of the branch in question, even though it were doubled or tripled, would represent only a small increase in the total air volume, no more than 3%, while an attempt to raise the resistance of the remainder of the system branches would have been almost seven times as costly from a power standpoint. Thus, it is evident, correct balancing must be done before the system is built and only after analyzing each branch resistance, air volume, and characteristics. The usual method of designing for the farthest branch and then inserting blast gates in the remaining branch pipes to bring each resistance up to the maximum is not only wasteful of power but it results in excessive maintenance and ultimate balancing.

Much unnecessary resistance is introduced by carelessness in the design of connecting fittings such as hood-to-branch pipe, junction fittings, inlet-to-filter, outlet-to-filter, and fan discharge. In Fig. 24 are illustrated various types of connections. Both efficient and inefficient pieces are shown as well as the resistance in terms of the velocity pressure corresponding to the pipe velocity indicated. In the hood-to-branch fitting it is desired to accelerate the air stream without the formation of a "vena contracta" or reduced air stream cross-section. This is relatively easy to accomplish since all that is necessary is to avoid sharp corners in the transition section, as shown. In the junction fittings, turbulence is set up due to too great an angle between the joining airstreams at the point of junction. By keeping this angle at a minimum the turbulence and resultant resistance may be kept at a minimum. In the inlet-to-filter connections (which are invariably grossly neglected), it is desired to reduce the air velocity without unnecessary shock losses. Since we are reducing from 4000 to 5000 fpm to practically no velocity, we cannot expect to make this reduction without some loss. However, by making this transition piece a diverging section with the included angle not exceeding 7 or 8 degrees the loss may be kept to a minimum. It is usually necessary to slope this piece down to an angle of about 45 degrees to prevent piling up of precipitated material in the piece. The outlet-to-filter piece should be made similar to the hood-to-branch pipe piece described. Since no material is conveyed beyond the filter, there is no necessity to maintain other nominal pipe velocities beyond this point. Thus, 3000 fpm should usually

prove quite satisfactory. However, in cases where huge air volumes are being handled and it is desired to keep the pipe diameters from becoming excessive, greater velocities are usually maintained. Thus, a similar condition to the inlet-to-filter condition will exist, namely the necessity of reducing the pipe velocity from a relatively high level to practically nothing, without undue losses. By diverging the discharge piece with an included angle of 7 to 8 degrees and maintaining the final diameter large enough so that the final velocity is less than 2000 fpm the discharge loss (loss of final velocity pressure) can be kept to a small fraction of its normal loss.

Fittings of standard construction are illustrated in Fig. 24. Both efficient and inefficient types of fittings and their resistances are given. Fig. 24a is a standard pipe friction chart very handy in correctly sizing piping and figuring resistances.

c. Air Cleaners

In general, the various types of air cleaners used in exhaust ventilation are the settling tank, inertial separator, cyclone, cloth flat-bag or tubular filter, air washers of the oil and water type, electrostatic precipitator, wet and dry revolving, fan-type, centrifugal separator, and those units combining two of these types. Almost all of these cleaners are suited to a single type of service and should not be used for other than that. For instance, the settling tank and inertial separator are used to drop out the heavier material being sustained in the air stream so that no unnecessary load with its attendant maintenance is added to the final filter, whatever the type. The settling tank illustrated in Fig. 28 is merely a large box in which the velocity has been so reduced that only fine material is left in the air stream. For effective scavenging, such a box should first of all be large enough in cross-sectional area so that the air velocity is no more than 1000 fpm as an absolute maximum. The lower the velocity, the more effective the cleaner. Besides being large enough to cause a reduction in velocity, the length should be great enough to preclude inertia of the material carrying it all the way across the box and into the outlet again. For instance, it must not be assumed that sustained material of any size traveling at a velocity as high as 4000 fpm is going to reduce its speed instantaneously to conform with the speed of the air stream sustaining it. Theoretically, the box must be made long enough so that sufficient time will elapse between the material's travel from one end to the other to allow it to fall below the level of the outlet. Due to the fact that boxes depending on gravity for precipitation become so huge as to be impractical, every effort should be made to assist nature by directing the material and entering air stream toward the bottom of box. Then, the box may be shortened considerably for the only factor tending to lift the material is air velocity and this is already very low. This feature of utilizing the inertia of the entering material to drop itself out is used quite effectively in much smaller inertial separators, which while not as efficient as the settling tank with inertial features, is nevertheless able to do a creditable job and occupies very little room, by comparison. Fig. 29 illustrates the inertial separator. Both the settling tank and inertial separator cannot be used effectively for the filtering of fine dust from the air stream but are only primary separators.

Another type of primary separator is the cyclone or centrifugal separator. This type of cleaner, illustrated in Fig. 27, introduces a relatively high velocity air stream (at least 3500 fpm) tangentially with respect to the periphery.

The air introduced leaves the cyclone at a relatively low velocity through a tube in the top center of the unit, which tube extends below the inlet. Since centrifugal force is the separating medium and this varies as the square of the velocity and inversely as the radius, it is obvious that the inlet velocity should be kept a maximum and the cyclone diameter a minimum if effective separation is to result. However, since it is necessary for the cyclone outlet to be a fixed size in order that the outlet velocity should not exceed 500 fpm, this fixes the minimum diameter below which we cannot go as twice the width of the inlet, plus the outlet diameter. While theoretically a cyclone can be used to separate out very fine material, it is best not used in such service. With high inlet velocities, small radii, resultant great turbulence, etc., the overall resistance to flow of such a unit becomes prohibitive, as much as 8 inches of water gauge, at times. On the other hand, well designed cyclones can be effectively used as primary separators for the elimination of coarse material and can operate with an overall resistance loss of less than 1.5 inches water gauge. Since wear is a major factor to be considered, where abrasive materials are being handled, heavy plate with replaceable sections should be used wherever necessary. Also, it is wise to sacrifice a little efficiency by making the diameter a little larger and the inlet velocity a little lower, for this will tend to increase considerably the life of the unit. Design dimensions for most conditions met are covered in Fig. 27 which is to be used in conjunction with Table 1. Individual conditions may suggest slight changes to fit the case in question.

Cloth filters are very effective cleaners for fine dust but while equally capable of filtering large particles out of the air stream should not be subjected to such service due to the severe wear and tear to which the cloth bags or tubes are subjected. While these filters cannot be used successfully to filter fumes or smoke nor can they be used safely where hot gases and dusts are being handled, nor efficiently where damp dusts are being conveyed, in almost every other case the cloth filter has proved itself a most efficient filter.

Cloth filters are made in two general types, those with flat-bag filters and those with tubular filters. Both types must be rapped frequently for effective, economical collection efficiency. Also, for long life and low resistance, air to cloth ratio should not exceed 3 cfm to 1 sq ft of cloth area. Reduction from this figure will prolong life of the unit and reduce the resistance to flow drastically. Increasing this figure acts in just the opposite manner. Illustrated in Fig. 25 is a cloth filter installation with properly designed inlet and outlet pieces and dust controlled discharge facilities.

Air washers are built in many types, some being adaptations of the cyclone separator with banks of spray nozzles, impingement plates, and moisture eliminators added. Others are merely huge boxes, similar to settling tanks, in which the air velocity is very low and in which a very effective wetting spray permeates the entire box. In general, it may be said that the principle of the washer is to wet the dust particles in suspension in the air stream, thus adding considerably to the weight of the individual particles and causing precipitation. In cyclone-type washers, since the separating factor, centrifugal force, varies directly as the weight of the material, increasing the weight of the particles by effective wetting definitely increases the separation or collection efficiency. Various methods are used in all types of washers to obtain more intimate mixing of the wetting medium and the solid particles in suspension. In the cyclone type, as illustrated in Fig. 26, the air stream in rising from the inlet to the outlet of the washer is given a number of twists resulting in the solid particle being forced to the periphery of the unit which is always well bathed and hence washes the material thus caught down the drain. The finer particles are eliminated in the upper portion of the washer by intimate contact with the spray.

Washers, in general, are very efficient collectors and can be used for both coarse and fine material collection, if desired. However, in many cases recovery of coarse material is desired in a dry state, which is the reason so many washer installations

DETAILS OF FIVE TYPES OF CLEANERS

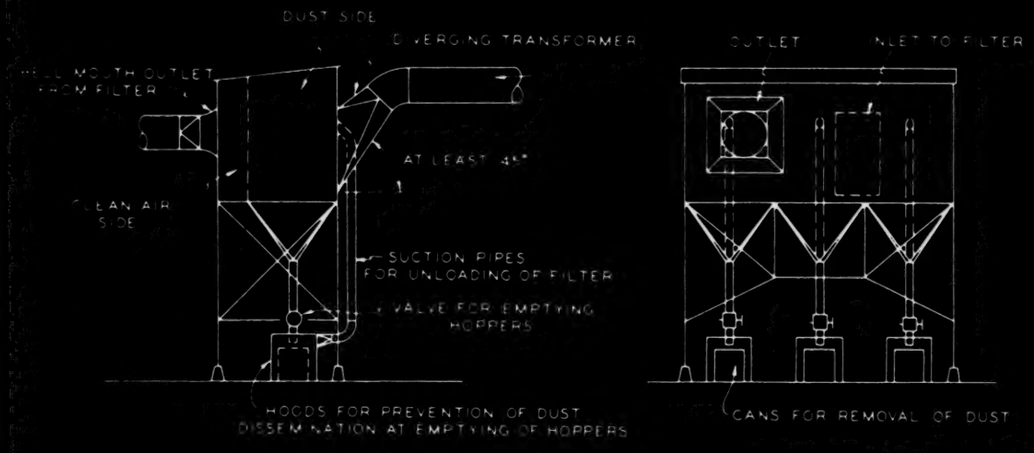

DUST SIDE
DIVERGING TRANSFORMER
OUTLET
INLET TO FILTER
BELL MOUTH OUTLET FROM FILTER
AT LEAST 45°
CLEAN AIR SIDE
SUCTION PIPES FOR UNLOADING OF FILTER
VALVE FOR EMPTYING HOPPERS
HOODS FOR PREVENTION OF DUST DISSEMINATION AT EMPTYING OF HOPPERS
CANS FOR REMOVAL OF DUST

FIG 25 - CLOTH FILTER INSTALLATION UTILIZING PROPER INLET AND OUTLET PIECES AND DISCHARGE HOODS

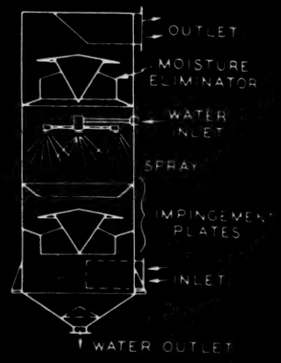


FIG 26 - CYCLONE TYPE OF AIR WASHER

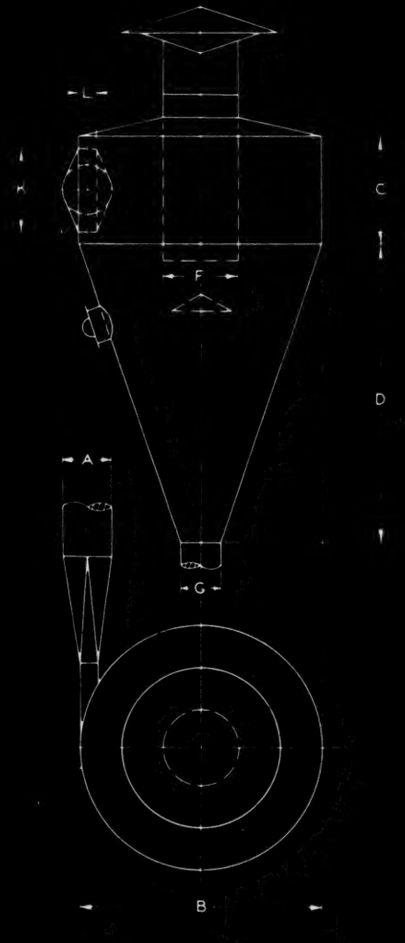


FIG 27 - TYPICAL CYCLONE AND DIMENSIONS

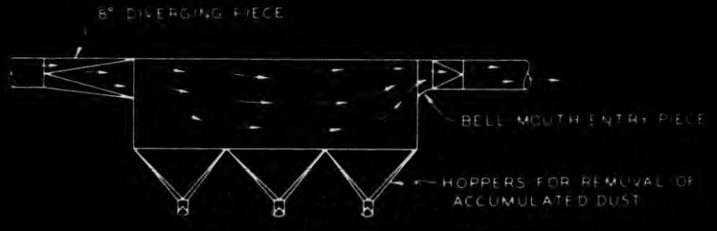


FIG 28 - (ABOVE) SETTLING TANK WITH NO INERTIAL FEATURES, AND (BELOW) USUAL LOCATION OF DEFLECTOR WHEN USED

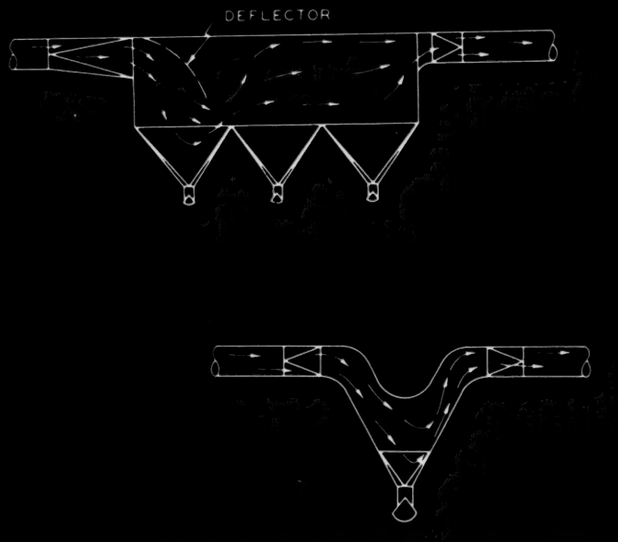


FIG 29 - TYPE OF INERTIAL SEPARATOR

TABLE 1. CYCLONE DUST SEPARATOR DIMENSIONS
(LETTERS ARE KEYED TO FIG. 27)

Fan Outlet, Diameter, Inches	Fan Outlet Area, Square Inches	Size of Inlet, Inches		Inlet Area, Square Inches	Air Outlet Diameter, Inches	Air Outlet Area, Square Inches	Dust Outlet Diameter, Inches	Outside Diameter of Cylinder, Inches	Height of Cylinder, Inches	Length of Cone, Inches	Shipping Weight, Lb.
A	—	L	K	—	F	—	G	B	C	D	—
5.....	20	2½	9	23	8½	56	3	29½	14	26½	70
6.....	28	3	10½	32	10	78	4	35½	15½	32½	100
7..... or 8.....	38 or 50	3½	13	47	13	132	6	41½	18½	37½	140
9.....	63	4½	16	72	15	176	6	47½	21	43½	175
10.....	78	5	18	90	17	227	6	53½	23	50	245
11..... or 12.....	95 or 113	5½	21	115	20	314	10	59½	26	56	315
13..... or 14.....	133 or 154	6½	24	156	23½	433	10	65½	29	61½	395
15.....	177	7	27	189	26	531	10	71½	32	67½	490
16..... or 17.....	201 or 227	8	30	240	28	615	10	77½	35	72½	575
18.....	254	8½	32	272	31	754	10	83½	38	77½	715
19..... or 20.....	283 or 314	9	35	315	33	855	10	89½	41	82½	875
21.....	346	9	40	360	36	1,017	10	93½	46	85½	930
22.....	380	10	41	410	39	1,194	10	97½	47	89	1,000
23..... or 24.....	415 or 452	10½	43	451	41	1,320	11	101½	49	93	1,095
25.....	491	11	45	495	44	1,520	11	105½	51	97	1,455
26.....	531	11	48	528	46	1,662	12	109½	54	99½	1,600
27.....	572	11	51	561	49	1,885	12	113½	57	103½	1,700
28.....	621	11½	54	621	52	2,123	12	117½	60	109½	1,855
29.....	660	12	57	684	55	2,375	12	121½	63	111½	2,035
30.....	707	12	60	720	58	2,642	12	125½	66	115½	2,155
31..... or 32.....	754 or 804	12½	63	807	61	2,922	13	129½	69	118½	2,250
33.....	855	13	66	858	64	3,217	13	133½	72	122½	2,420
34.....	908	13½	69	932	67	3,525	13	137½	75	126½	2,555
35.....	962	14	72	1,008	70	3,848	14	141½	78	129½	2,745
36..... or 37.....	1,017 or 1,075	14½	75	1,087	73	4,185	14	145½	81	133½	2,900
38.....	1,134	15	78	1,170	76	4,536	14	149½	84	137½	3,065
39..... or 40.....	1,194 or 1,256	15½	81	1,255	79	4,901	14	153½	87	141½	3,235
41.....	1,320	16	84	1,344	82	5,281	14	157½	90	145½	3,395

include cyclone separators as primary cleaners. Washers are ideally adapted to fumes, smokes, hot dusts, or wetted dust collection. Occupying less space, requiring simpler structural supports, being considerably cheaper in first cost, and requiring less time and money for erection than a cloth filter of the same capacity, it has many desirable characteristics which make it the logical choice in many exhaust installations. Where the material caught must not be wetted and where a still higher collecting efficiency of fines is desired, the washer must give way to the filter or the electrostatic filter.

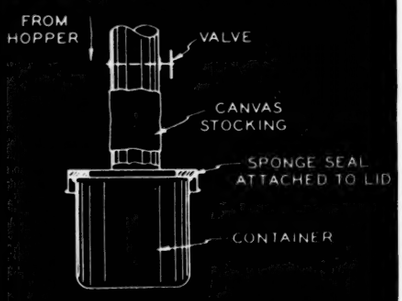
Fan-type centrifugal separators, called Roto-clones, are patented. These units are shown to have a high collecting efficiency and have the attributes of requiring no fan and drive other than that integral with the unit, little space, low initial cost, and low erection cost. It is furnished in two types, the dry and wet units, the wet being a more efficient collector on fine material. Where ordinary non-abrasive material is being collected, such filters make very desirable and effective installations.

The general principle of collection in such units is to first pass the air stream through a scavenging or primary cleaning chamber, thus eliminating the larger particles in suspension. Then the air stream is introduced to the fan inlet in the same manner that any air stream enters the inlet of a centrifugal fan, axially. The fan wheel is specially shaped so that the entering material is caught in the blades, of which there are very many in close relationship to one another. Due to the centrifugal force set up in the wheel, the material is forced outward radially where it is caught in a special chamber leading to a hopper. The action is very much the same in both the wet and dry installations, except that both primary chamber and the fan wheel are well wetted in the wet type, increasing the collecting efficiency and decreasing the tendency to wear. The water consumption in such units is not a major item for consideration being only a very few gallons per minute per 1000 cfm of air handled.

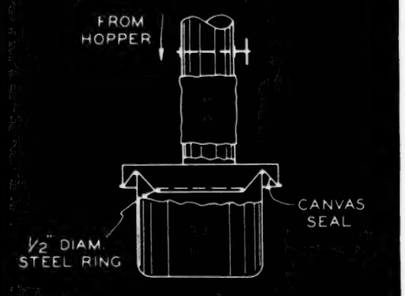
The general characteristics of operation of the electrostatic air cleaners are as follows: the air stream is passed through a chamber in which are located a number of positively charged electrodes, each of which is centrally located with respect to electrically-grounded pipes or plates, being also insulated from them. Under the influence of a strong electrostatic field, the entrained material is ionized and collected. Periodic vibration of the collector elements is necessary to drop the collected material down to the hopper. The resistance loss through such a filter is almost negligible while the collection efficiency is high. It

FILTER CLEANOUTS

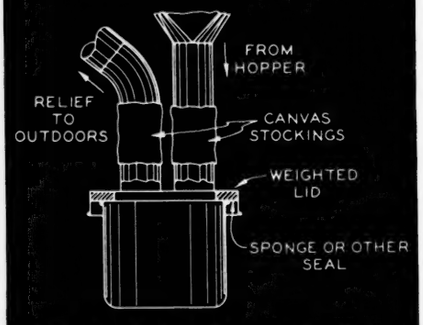
FIG. 30



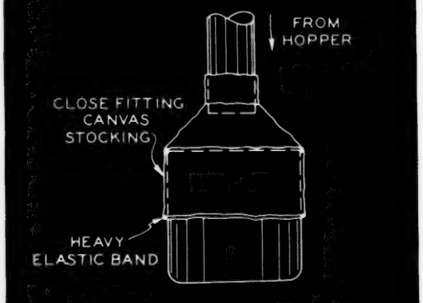
SPONGE SEAL TYPE



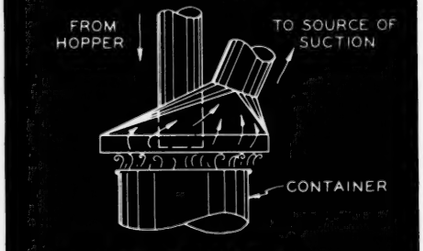
WEIGHTED CANVAS SEAL



RELIEF TYPE – DISPLACED AIR ESCAPES TO OUTDOORS



CONTAINER STOCKING TYPE



EXHAUST HOOD TYPE (MOST EFFECTIVE)

is especially adapted to the reclamation of valuable materials suspended in the air stream, or to dust collection in which there is a preponderance of extremely fine dust. Fumes, smoke, etc., are also effectively collected by this device. The one disadvantage of the electrostatic precipitator is its relatively high initial cost. Transforming and rectifying equipment are necessary for the production of the very high uni-directional voltage necessary for effective operation.

d. Fans

Since in exhaust ventilation certain conditions of performance and operation must be met, it is necessary that care be exercised in the choice of specification of fans. For instance, most exhaust systems operate continuously, day in and day out. Most exhaust systems have a characteristically high resistance drop, which requires a fan capable of working against such resistance. The combination of high volume and high resistance necessitates either an abnormally large fan or a relatively high speed fan. Again, to operate at high speeds, a fan must be ruggedly constructed, besides being in perfect static and dynamic balance. Some fans are required to handle dust, corrosive fumes, etc. In each particular case the material and construction must suit the service. For instance, fans of the forward-curved, short, multi-vaned type are not suited to the handling of solids, since the construction is too light and material has a tendency to build up on the blades, throwing the fan out of balance. Again, since this type of fan is easily overloaded with a reduction in resistance (such as would result with a break in a branch or main), it is not good practice to incorporate it into an exhaust system.

When it is necessary that a fan handle solids (this should be avoided wherever possible by placing the fan after the filter so that it handles only clean air), then the fan specified should be the radial bladed paddle-wheel blower; a good example of such a system is the wood shavings system used in woodworking mills. The radial-bladed fan, if carefully chosen, has a satisfactory efficiency and an excellent maintenance record. It is the most rugged of all fans, although not necessarily the most expensive due to its simple construction. Fans of this type will operate at efficiencies as high as 60%. Due, however, to the efficiencies obtainable with backward-curved blade fans, preference should be given this type over all others in spite of its higher first cost. Such fans can operate at efficiencies as high as 80% and when handling large air volumes at high resistances even a slight increase in efficiency results in a decided power saving. Backward-curved blade fans should not be used

to handle air containing solids, but should be placed after the filter.

Propeller fans are on the market which are capable of operating at reasonably high resistances such as 2 inches water gauge. For many well-designed exhaust systems in which the resistance has been kept down to a minimum, such fans prove efficient air movers. The propeller fan, in the past, has been employed to handle air volumes at a relatively low static pressure, lower than 1 inch water gauge. The centrifugal fan, on the other hand, has been used wherever it was necessary to work against resistance or where quietness was essential. Now that propeller fans are available which can work against resistance, full benefit should be taken of the advantages they offer such as low initial cost, minimum space requirements, simplicity, high efficiency, and satisfactory maintenance characteristics.

One disadvantage of the propeller fan is the method of driving the wheel. It is either necessary to provide the wheel with a long shaft which can extend all the way through a specially-built elbow, with the motor mounted on the outside of the elbow, or it is necessary to have the chain or belt drive extend through the side of the duct. In some cases a streamlined (airfoil-shaped) sleeve is built into the duct which allows the drive to run through it in connecting with the fan sheave or sprocket. In other cases the complete drive is placed in the center of the duct, the duct is widened at this point, and an enclosure is placed around the motor and drive which isolates it from the air flowing within the duct but leaves it accessible for inspection and repair from the top or bottom. Other types are directly driven (fan is mounted on the motor shaft), with the motor directly in the air stream. Each type has its own advantages and will be best suited for certain, distinct types of service. Availability of replacement parts, etc., will help determine, for instance, whether a fan driven through an elbow, through a sleeve, or by an explosion-proof motor, or a water-proof motor, etc., should be used.

Where it is desired to use a propeller fan beyond the resistance range of such fan types and the sizes available do not cover adequately the performance characteristics necessary, two or more propeller fans can be arranged in series to give the desired results.

Fans of any type and size, provided they are the same size and type, when arranged in series and running at the same speed yield the same volume as one against a resistance equal to the product of the resistance rating of one and the number of fans used. Fans arranged in parallel merely multiply the volume but maintain the same resistance. Fans of different types, sizes, and running speeds may be used together but care will have to be exercised in the determination of the expected volumes and resistances. While consulting the fan manufacturer in such cases is always a wise move, it is also well to run performance tests on the exact hookup desired. It is still safer to avoid such peculiar arrangements and stick to reasonably predictable set-ups. Propeller fans are available in many sizes, types and blade arrangements. Fans of 2, 3, 4, 6, and 8 blades are standard, as are multibladed fans. Fans with a fixed or variable pitch, with steel or aluminum alloy blades, and with varying performance characteristics are available. While some fans have a pretty constant pressure-volume performance curve, others fall sharply in volume with an increase of pressure or resistance.

e. Venturi Jet

There has been previously discussed under the heading Venturi Ejector the use of steam, water, and waste gas in primary jets. Since, for effective operation with air the jet velocities must of necessity be high, blowers capable of working against a resistance of at least ½ lb per sq in are necessary. Sometimes, it is necessary that blowers capable of 1 or 2 lb pressure be used. Where such blowers are not immediately available, centrifugal fans arranged in series and used in duplicate or triplicate can be used. Rotary blowers, while noisy, are effective and efficient primary jet air movers as are air turbines. Both, however, are more costly than centrifugal blowers of the same output, where available.

f. Motors

The type of motor used must, of course, be determined by the electric service available, the fan operating characteristics, and the system characteristics. Whether or not a motor is to be constant or variable speed will be determined largely by the type of system used. While a plenum system has the advantage of being able to operate just as well when half the branches are shut off, a graduated main system will not long function well if subjected to the same treatment (precipitation in mains will occur). Thus, there is little necessity for a variable speed motor with many systems. Since variable speed a.c. motors are a relatively recent development (slip-ring motors have been manufactured for years but do not have the wide range of regulation possessed by the new type), many buyers will prefer to rely on other means of speed regulation.

g. Drive

The drive to be used is determined by the type of service to be encountered and the motor chosen. If the fan and motor are to run at the same speed, then a flexible coupling is the obvious means of connection between the two units, regardless of the type of motor. If, however, the fan and motor are to run at different speeds, belted, chained, or geared drives are the answer. For most small and medium sized installations V-belts and pulleys are the lowest cost type of drive, and quite satisfactory. Where drive linear speeds can be kept low, and if the load is great enough to warrant it, sprockets and chain make an extremely efficient and long-lived installation. For still greater loads, with high starting torque, gearing may be used. Two or more gear ratios can be used with this method to give step-reduction in volume, similar to the two-motor setup previously explained. For full range speed regulation, without "steps," and with excellent efficiency characteristics, the hydraulic coupling may be used. Since such a device is expensive, the system size would have to be appreciable to warrant such purchase.

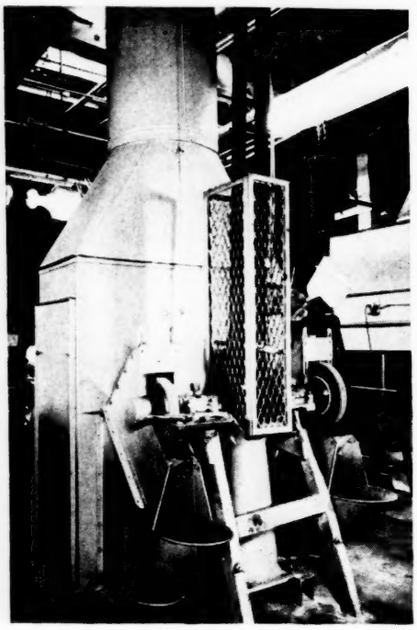
h. Filter Cleanout

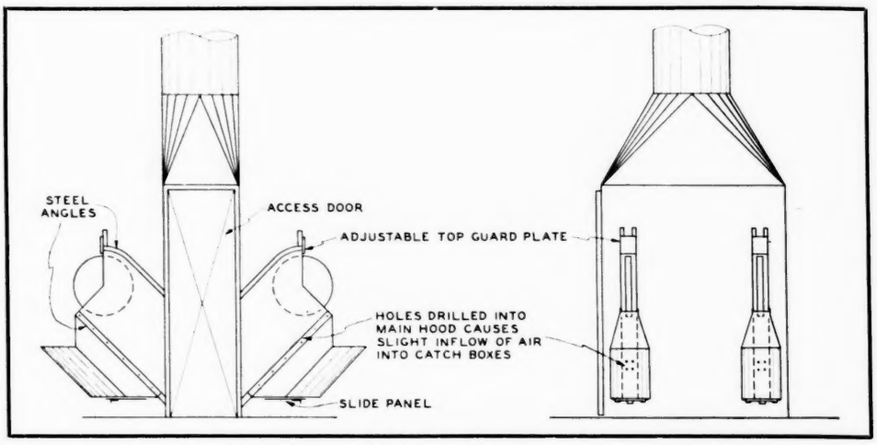
Too often careful thought is given to the design of an extremely efficient exhaust system and no thought at all to the filter cleanout. It is axiomatic that if it is important or desirable to catch the dust to begin with, it is equally important that it not escape into the atmosphere again and repeat the nuisance or hazard. Very often, in the emptying of cloth filters, cyclones, settling tanks, etc. (wherever dry, fine dust has been collected in quantity), a fair portion of this dust escapes in a huge cloud formation which spreads all over the immediate vicinity. The reason is that no measures have been provided to control this dust nuisance or hazard. Fig. 30 illustrates various means adopted to prevent this dust condition at the filter cleanout. As can be seen, some measures are more elaborate than others. Where the filter cleanout is out-of-doors, it is not so necessary to go to extremes as is the case where the filter cleanout must, of necessity, be placed indoors. Regardless of the measure finally adopted, it should accomplish its purpose completely—namely, control the operation of dust transfer. If, after much money, time, and effort have been expended in order to successfully catch a dust nuisance, we carelessly permit it to escape again, the system as a whole can not be called satisfactory. Hence, the necessity for care in this final detail.

APPLICATIONS

The eleven installations described on this and following pages are not intended to illustrate all possible combinations of equipment used for industrial exhaust but merely to indicate the wide variety of such combinations and the equally wide variety of uses, processes or functions to which such combinations may be applied.

METAL-WORKING PLANT




STEEL ANGLES
ACCESS DOOR
ADJUSTABLE TOP GUARD PLATE
HOLES DRILLED INTO MAIN HOOD CAUSES SLIGHT INFLOW OF AIR INTO CATCH BOXES
SLIDE PANEL

In this installation the grinding dust exhaust system is of the low-velocity settling basin type. This type of system has a number of differences from the conventional type using a centrifugal type exhauster and a cyclone dust collector. It does not convey the dust through blow pipes, but drops the dust into a settling chamber adjacent to the grinding wheels. This system is constructed of easily fabricated sheet metal panels which can be readily made by any sheet metal contractor. The initial cost of this type of system is often lower than that of the ordinary blow pipe system, due to lower cost of equipment.

The drawing and photograph show this system. The grinding wheels are enclosed within steel hoods constructed to conform to the local labor department provisions. The dust particles slide and are blown down the inclined bottom panel of the wheel hoods. When the air reaches the settling chamber, it turns sharply upward, dropping the dust which settles to the bottom of the chamber. The upward velocity is comparatively low so that only a minimum quantity of very fine dust is entrained and carried upward.

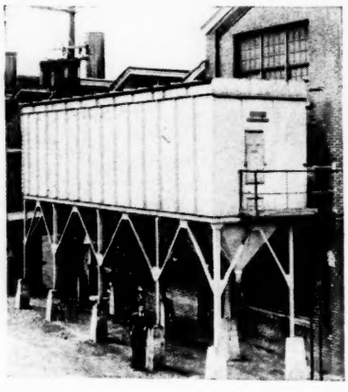
The air is discharged in an upward direction into the atmosphere through a ventilator constructed the same as that described under "Fan Wheel Sanding." This consists of a hood which turns with the wind and prevents the entrance of rain, while allowing the discharge air to escape easily. The fine dust which may be entrained in the discharge air is dissipated into the atmosphere and is invisible.

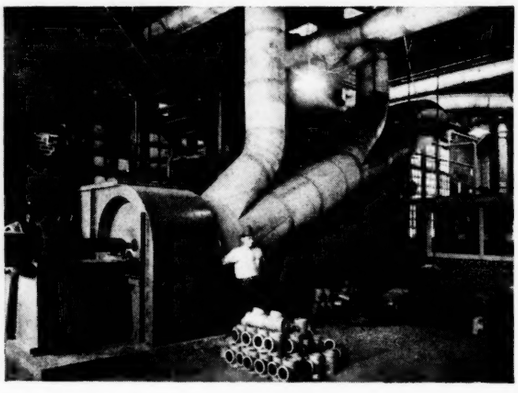
Note the dust boxes installed directly beneath the wheel hoods. These boxes catch dust which is thrown off centrifugally and impelled at high velocity from the periphery of the wheel. A small volume of air is drawn into these boxes by means of several small holes in the lower panel of the wheel hoods. This small volume of air prevents any dust from rising due to the vibration of the hoods.

The dust boxes are easily emptied periodically by opening a slide panel in the bottom. The main settling chamber is easily cleaned by opening the large access door seen on one end of the chamber.

If this dust exhaust system were constructed in the standard manner using a blow pipe and centrifugal fan, the brake horsepower requirements would exceed 3, thus necessitating a 5 hp motor. However, by means of a propeller type fan (a Wing straight line exhauster) together with the proper sheet metal construction, this system is operated with a brake horsepower ranging between .5 and .75, thus necessitating only a 1 hp motor.

WALWORTH COMPANY



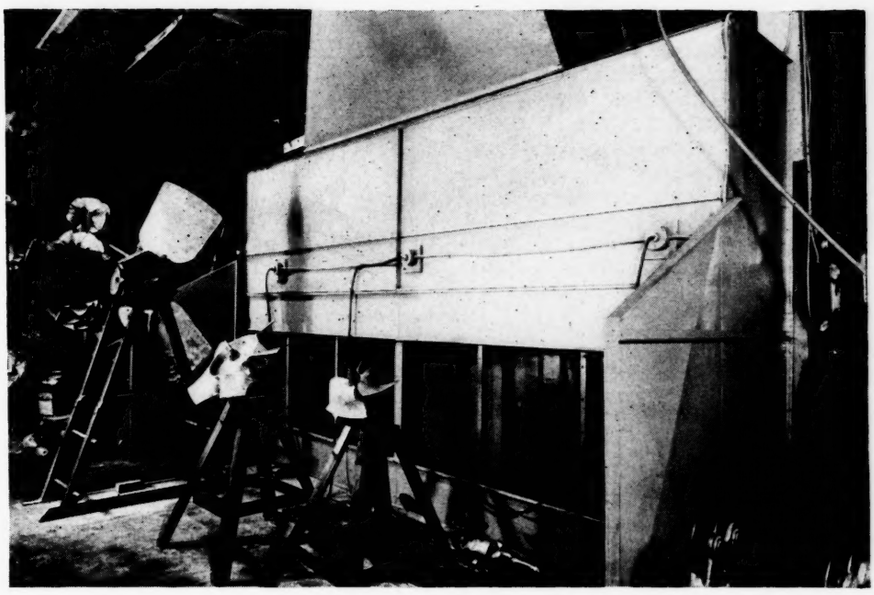


The accompanying illustrations show part of the equipment installed at the Greensburg, Pa., plant of the Walworth Company. At this plant there are 16 grinding wheels, a suction air blast cabinet, an airblast barrel, a hard iron tumbling mill, two Wheelabrator Tumblasts and a shakeout system for soft iron anneal. The view to the right shows the blower and the inlet ducts serving this equipment. The other view illustrates an American dust collector outside of the building where the dust is discharged and collected.

FAN WHEEL SANDING

The accompanying photograph shows a dust exhaust booth built for removal of dust created by portable sanders used in the finishing of aluminum castings. The booth was comparatively inexpensive to construct and operates extremely well at low power consumption.

The system consists of a sheet metal settling chamber with side closing extensions. The booth is sufficiently large to accommodate three operators simultaneously. The dust created by the sanding operation is drawn downward away from the breathing zone. As the air enters the settling chamber, it turns upward sharply. Then it rises at a very low velocity. The sharp upward turn of the air stream and its low velocity cause the bulk of the dust to be deposited within the chamber behind the low baffle plate at the floor.

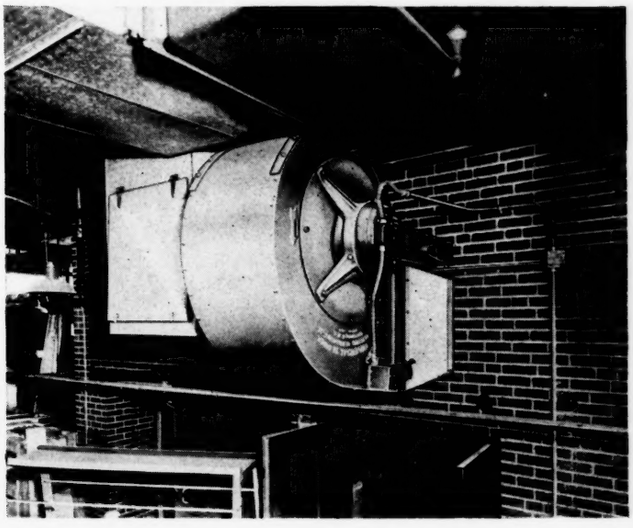


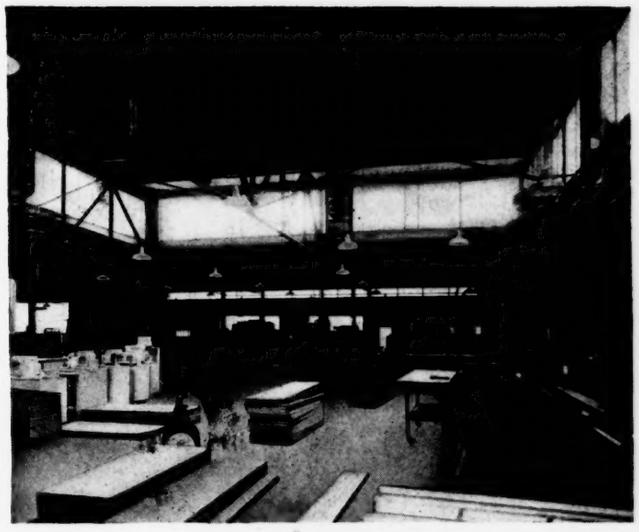
Only a small percentage of the very fine dust is lifted by the low velocity air and discharged through the roof by means of a sheet metal stack. The top of the stack is weather-proofed by means of a special ventilator head which turns with the wind to prevent entrance of rain. The slope of the ventilator head allows a free escape of discharged air in an upward direction. Thus, the fine dust is carried away by the wind. On this installation, it was found that the escaping dust was completely invisible and did not settle upon the roof at all.

The air is moved by a Wing straight line exhauster mounted vertically, blowing upward. The exhauster is mounted upon a curb built onto the roof. It is driven with a 1 hp motor equipped with a variable pitch driving pulley so that the air volume can be regulated. The distribution of the air flow can be controlled by the movable panels of which the front of the booth is constructed.

The exhauster is equipped with a propeller fan. The brake horsepower is 0.72, thus requiring a 1 hp motor. If this dust exhaust system was of the conventional type over 10 brake horsepower would be required, thus necessitating the use of a 15 hp motor. These comparative figures show the tremendous power saving that can be achieved by the use of a propeller type fan together with properly designed sheet metal construction.

DUKE MANUFACTURING COMPANY

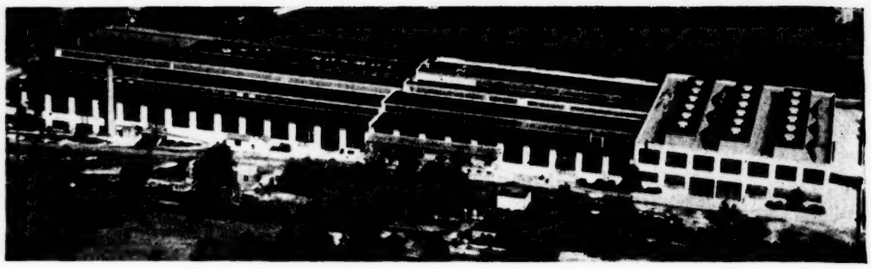




In the St. Louis plant of this company where kitchen equipment, food serving and dispensing equipment for restaurants and similar devices are manufactured and which for the past year or two has been heavily engaged in making equipment for Army and Navy mess halls, air is exhausted by four 30-in. Ilg propeller fans as shown in the accompanying illustration. These are located in the monitors. Fresh air to the department, to make up for that exhausted, is supplied by an Ilg 55-in. direct-connected blower which draws air from the outside and distributes it through heating coils and filters into the paint and drying department.

BLACK AND DECKER MFG. COMPANY

In the Towson, Md., plant of this company it was desired to ventilate, for comfort reasons, two rooms each of which measures 100 x 140 ft, a total floor space of 28,000 sq ft. These rooms had a ceiling height of 14 ft with monitors 7 ft high making the overall height in the monitors 21 ft. One of the rooms is occupied by approximately 100 white collar workers, the other by 360 workers, about 80% of whom are women engaged in light manufacturing, service and general experimental work.

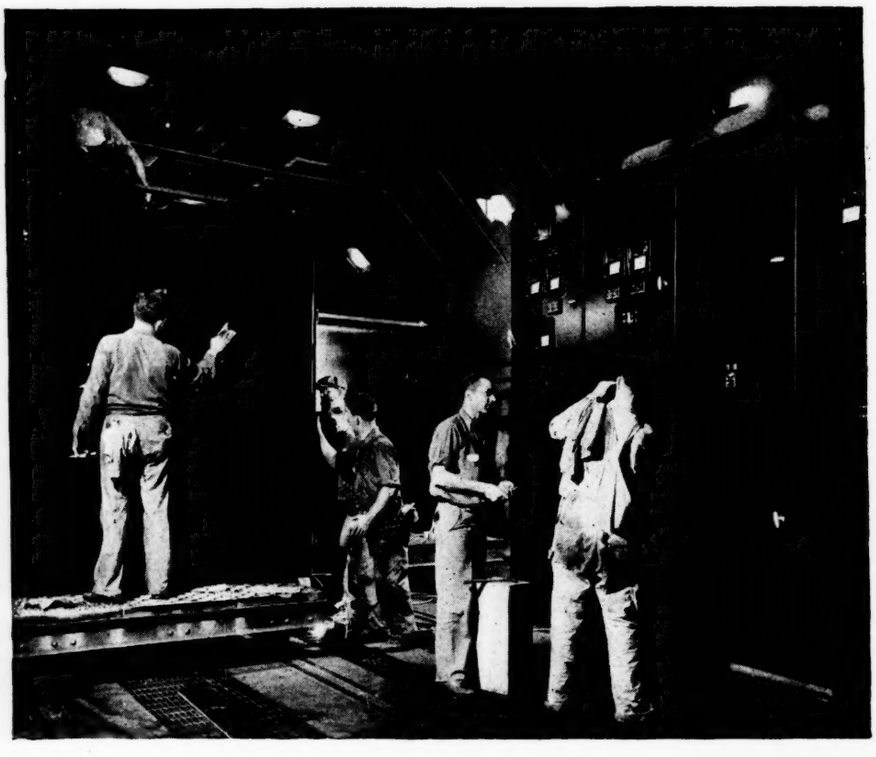


In the past atmospheric conditions in these rooms have been satisfactory excepting in warm summer months particularly when the humidity was high. The original intention had been to use wind-operated ventilators, but use of these, or even mechanical ventilators, would require the closing of the monitors, for otherwise there would have been a short circuiting of air and the ventilating effect would not have reached the floor line. It was therefore necessary to install exhaust equipment with a capacity equivalent to that of the monitors before it could be considered that the building would be as well ventilated with the monitors closed as it had been in the past with the monitors open, but only after equipment beyond that extent was employed could an improvement be experienced. The engineers recommended that the monitors be closed and that exhaust equipment be provided to change the air once every minute, and that provision be made to allow air to come into the building as near the floor line as possible.

Consequently, approximately 20 Allen type H roof fans, 54 in. in diameter, were installed. These provide a slow-moving but continuous flow of air in an upward direction without drafts. The resultant conditions are such that the workers are comfortable.

This job was engineered by Frederick G. Volz, president, and O. D. Hendrickson, Baltimore representative, of The Champion Sales Company, sales representatives for The Allen Corporation in this area. C. C. Ferrel cooperated in the work.

WESTINGHOUSE ELECTRIC & MFG. CO.



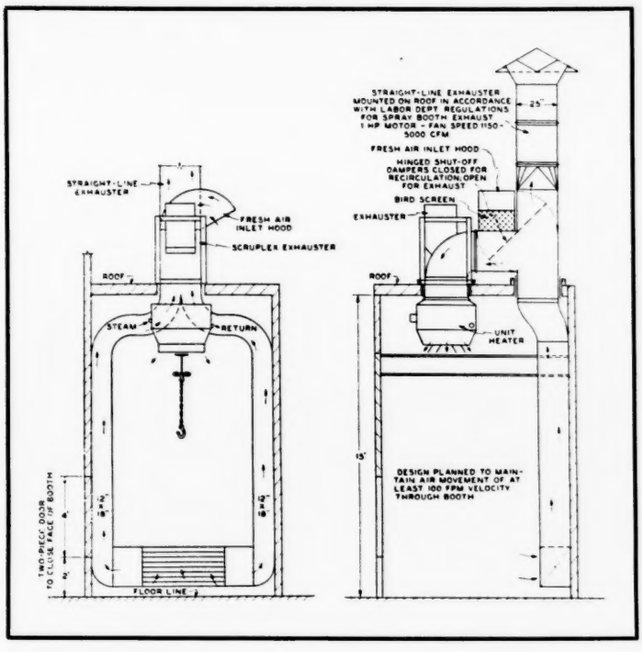
In the recently-completed paint shop at the Westinghouse East Pittsburgh works, switchgear panels and switchboards are brought in for painting on flat-topped trucks that run on tracks from the assembly aisle through the paint shop and on out to the shipping floor. A feature of the booth is the method of handling the clean ventilating air. A down draft system is used whereby air from outside the booth, 70 by 25 by 15 feet high, is drawn through the ceiling. The air is cleaned as it passes through 180 wire mesh washable filters, each 20 by 20 by 2 inches thick, covering the entire ceiling area. Paint spray in the room is carried downward with the air through open grille work in the floor and is deposited on a water surface in a pit covering nearly the area of the floor. The water in the pit is recirculated by four motor-drawn pumps each having a capacity of 5000 gallons. Makeup water is supplied to retain the proper water level.

The air drawn downward through the floor grille is expelled to the shop by four fans, each driven by a 15-hp motor. Total air exhausted is about 200,000 cfm, the equivalent of 380 air changes per hour.

AIRPLANE FACTORY

At the plant of an aircraft manufacturer the work of cleaning of grease from new airplane motors previously prepared for long storage periods made it necessary to design a special room for this work and this, in turn, required special heating and ventilating. The cleaning solution used is 50% carbon tetrachloride and 50% gasoline.

The motors are suspended from the hook in the center of the cleaning room, and the first operation is to warm up the unit and keep it as warm as possible. This is accomplished by using a Wing Featherweight unit heater supplied with steam at 100 lb pressure. During this operation, the damper in the exhaust stack is placed in the closed position, causing the air within the room to recirculate through the heater section. Thus, the temperature in the room is built up to over 200F. During the warming-up period, which requires about thirty minutes, the hot air is continually circulated around the motor suspended from the chain.


STRAIGHT-LINE EXHAUSTER
FRESH AIR INLET HOOD
SCRUPLEX EXHAUSTER
ROOF
STEAM
RETURN
TWO-PIECE DOOR TO CLEAR FACE OF BOOTH
FLOOR LINE
STRAIGHT-LINE EXHAUSTER MOUNTED ON ROOF IN ACCORDANCE WITH LABOR DEPT REGULATIONS FOR SPRAY BOOTH EXHAUST 1 HP MOTOR - FAN SPEED 1150 - 5000 CFM
FRESH AIR INLET HOOD
HINGED SHUT-OFF DAMPERS CLOSED FOR RECIRCULATION, OPEN FOR EXHAUST
BIRD SCREEN
EXHAUSTER
ROOF
UNIT HEATER
DESIGN PLANNED TO MAINTAIN AIR MOVEMENT OF AT LEAST 100 FPM VELOCITY THROUGH BOOTH

The second operation is the removal of the now softened grease by means of a spray gun, or atomizer. This method of cleaning has been used on automobile motors for years. During this spraying-cleaning operation, the 4 ft doors on the face of the cleaning room are kept open, and the damper is placed in the open position. The Wing straight-line exhauster on the roof is placed in operation. This causes the former recirculating duct to be used for the exhaust of the fumes from the spray. At the same time, the repositioning of this damper opens a fresh air inlet to the heater section which continues to function and deliver air into the room at a predetermined room temperature to replace the exhausted air. The spraying-cleaning operation also requires about thirty minutes.

The installation of this airplane motor cleaning room reduced the previous time of cleaning these motors from something over four hours to approximately one hour. The first of these rooms installed worked so satisfactorily that an additional installation has since been made, using the same design. This unit handles 5000 cfm; on a zero day its steam consumption is approximately 500 lb of steam per hour.

One of the exhausters used is of the Scruplex elbow-extension shaft type, while the other is the straight line type, V-belt driven. The elbow type is used to recirculate the air through the room and heater section as the temperature is built up. The elbow type exhauster is particularly applicable to this purpose since it replaces one of the elbows in the sheet metal work. For exhausting the waste fumes resulting from the spraying-cleaning operation, the straight line exhauster is more applicable, since it can be mounted upon the roof very easily in such a manner as to form a portion of the discharge stack.

MARION TOOL WORKS, MARION, IND.

Obviously a multi-chamber dust collector such as illustrated under the Walworth Company would not be necessary in the case of a small exhaust system. At the plant of the Marion Tool Works an exhaust system is provided to ventilate numerous grinders in their machine shop but the system is relatively small. The accompanying photograph illustrates the American Cyclone dust collector used for a system of this type.

FLEETWINGS, INCORPORATED

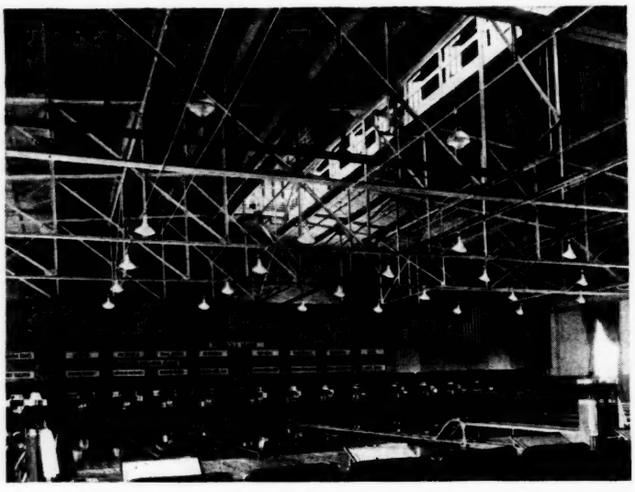
This company manufactures Fleetwings Basic Trainer planes at its Bristol, Pa., plant. These are the first stainless steel military planes ever made. In the plant it was necessary to provide means to remove the heat, smoke and welding fumes from the many welding machines. The heat load from the working zone added to the solar heat load at times calls for motors capable of continual operation under severe conditions in order adequately to ventilate the plant. To provide for the removal of this heat six 42-in. llg propeller fans were installed in penthouses as shown in the accompanying view. In addition to this there are also six 30-in. units exactly similar used in a smaller building for the same type of work.

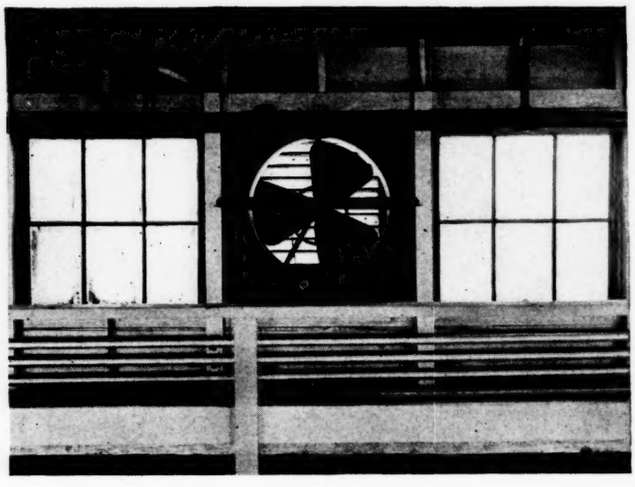
WELLSTON BOWLING ALLEYS

Strictly speaking a bowling alley is hardly an industrial plant but in the installation here described and illustrated the problem of ventilation was one approximating the problem found in factory type buildings. In these alleys located in St. Louis it was necessary to move a large volume of air at a low velocity for cooling and ventilating and to eliminate food odors from a cafe located in the front of the building and separated from the bowling alleys by an eight foot partition which extends part way to the ceiling. Due to the fact that there are sixteen alleys and, at times, not all in use, it was desirable to have a cooling system that could be controlled as to the zone of occupancy. That is, to cool the entire sixteen alleys or the eight on the east or the eight on the west, as occasion demands.

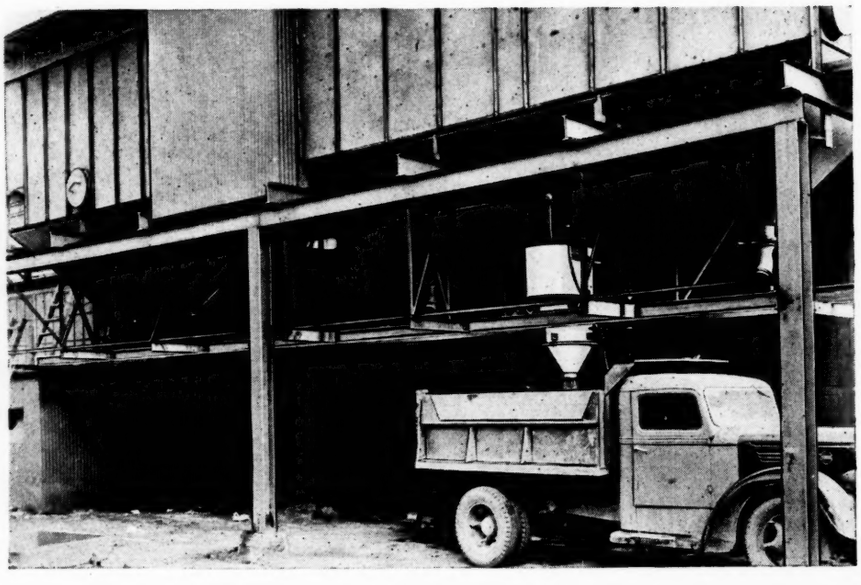
In this job an air change every minute and a half was deemed adequate. This required thirteen Wagner belted cooling fans. These fans were mounted as is shown by the accompanying photographs, seven on the east side and six on the west side of the pent house. The fans are controlled from a switch panel, and are so wired that all thirteen may be operated, every other fan or either or both sides or the first fan on each side. The last combination is for winter ventilation only. This hook-up makes the installation very flexible as to air control and most economical in power consumption. Only sufficient equipment need be operated as is required to meet the varying cooling load demands.

In a cooling system of this type doors and windows become "control valves" and are used to zone the cooling effect. To illustrate this statement, suppose the eight alleys on the east side are in use but not those on the west. The west windows should be closed and those on the east open, allowing outside air to enter and cool the east group of alleys. It would be necessary to operate only seven of the thirteen fans.





WILLIAMSON HEATER CO.



Where dust collectors are used in heavy dust emitting plants such as foundries, the collection of the dust becomes a problem. One method of disposing of it is to use a wet disposal unit designed to wet and mix with water the collected dust discharged from the hoppers of the dry type collectors and deposit it near the center of a high-speed mixing disc. At the same time water or other liquid is discharged at the center of the disc causing a mixture of the two which flows out of the discharge at the bottom of the unit in the form of sludge which can then be carried away. The accompanying illustration shows a unit of this type as manufactured by American Foundry Equipment Company and in use at the Williamson Heater Co.'s Cincinnati plant.

A limited number of reprints of this 24-page section on Industrial Exhaust Ventilation are available at 25 cents each, postpaid, from HEATING AND VENTILATING, 148 Lafayette Street, New York, N. Y.

ABSTRACTS of Current Papers, Books and Pamphlets

Industrial Instruments for Measurement and Control

In recent years there has been an enormous increase in the number of control instruments used in industry and at the same time the instruments have become increasingly complicated. For this reason there is a need for a book which would point out the principles upon which these instruments are based and classify them so that the engineer could get a clear picture of the field. This has been done in this book entitled "Industrial Instruments for Measurement and Control."

The author points out that this book is for use both as a textbook and a practical reference book for those who are concerned with instruments and control problems in industry. He has made no attempt to include descriptive material on all available types of instruments but rather has included only descriptive material which helps to make clear the theory being studied or represents a different solution of a particular instrument problem.

The material in the book consists largely of information for the measurement and control for four physical and thermal qualities—temperature, pressure, flow, and liquid level. Some additional quantities are also taken up in this book but others, such as weight, are not described since they involve equipment not classified as instruments according to the author's definition.

The book is made up of eleven chapters as follows: Standards; Pressure and Vacuum Gauges; Indicating and Recording Thermometers; High-Temperature Pyrometry; Theory of Differential-Pressure Flow Meter Secondary Measuring, Recording, and Integrating Elements; Miscellaneous Inferential and Volumetric Flow Meters; Liquid-Level Measurement; Telemetering; Automatic-Control Theory; Automatic-Control Mechanisms, and Miscellaneous Industrial Instruments.

[*"Industrial Instruments for Measurement and Control," by Thomas J. Rhodes. Published by the McGraw-Hill Book Company, Inc., 330 West 42nd St., New York, N. Y. Cloth cover; 6¼ x 9½ in.; 573 pages. Price, $4.*]

•

Heat Transmission Through Textile Fabrics

In most cases clothing is worn because of its ability to act as a heat insulator and it is well-known that different cloths vary considerably in their heat insulating ability. This paper reports on an apparatus constructed for measuring the heat transmission through textile fabrics under conditions which are similar to those encountered in service. This apparatus was able to measure the heat conductivity for various humidities, temperatures, and air velocities. As was to be expected it was found that the less dense fabrics have the lower heat conductivity. It was found that the various materials varied as follows in the order of increasing conductivity: wool; wool and rayon fabric; rayon and cotton fabric; cotton; silk; silk and rayon; multiple cotton fabric.

One interesting point noted in these tests was that certain fabrics caused the hot plate testing apparatus to cool slightly when the fabric was first brought into contact with it. The investigators believe that this was due to the coolness of the samples and point out that this was an important feature in regard to comfort in putting the clothing on next to the skin. Their tests showed that the fabric with the coolest feeling was rayon and silk. Closely following this was silk cloth, bleached cotton, and linen cloth. Cotton blankets and wool blankets, on the other hand, showed no cooling effect.

[*"The Transmission of Heat Through Textile Fabrics," by W. Howard Rees. Published by the British Cotton Industry Research Association, Shirley Institute, Didsbury, England. Paper cover; 37 pages; 6 x 10 in. Available from the British Cotton Industry Research Association. No price quoted.*]

•

Storage of Fruits, Vegetables and Florists' Stocks

The purpose of this circular is to present a series of brief summaries of essential storage requirements of most of the more important varieties of fresh fruits, vegetables, cut flowers, and other commercial commodities that enter the market on a commercial scale. The bulletin gives a considerable amount of information on such factors as effective temperatures of storage rooms, humidities of storage rooms, the various heat given off by the various commodities and the effects of cold storage on the behavior of fruits and vegetables.

[*"The Commercial Storage of Fruits, Vegetables, and Florists' Stocks," by Dean H. Rose, R. C. Wright, and T. M. Whiteman. Published by the U. S. Department of Agriculture, Division of Fruit and Vegetable Crops and Diseases, Bureau of Plant Industry. Circular No. 278. For sale by the Superintendent of Documents, Washington, D. C. Price, 10 cents.*]

BRIEF REVIEWS

Drawing Standards. A bulletin on the American Standards Association graphical symbols for use on drawings in mechanical engineering. The symbols for the following type drawings are included in this bulletin: Plumbing; piping, including heating, air conditioning, plumbing and pneumatic tube piping; pipe fittings and valves; heating and ventilating; ductwork; heat-power apparatus; conventional rivets; refrigerating, and welding. [*"American Standard Graphical Symbols, ASA Z32.2 — 1941." Published by the American Society of Mechanical Engineers, 29 West 39th Street, New York, N. Y. Paper cover; 8½ x 11 in.; 20 pages. Available from the American Society of Mechanical Engineers or the American Standards Association, 29 West 39th Street, New York, N. Y. Price, 50 cents.*]

TUNNEL VENTILATION. A report describing the results of a study of carbon monoxide and particulate matter in air of the Holland Tunnel and metropolitan New York. Main purpose of the study was to obtain information on the dissemination of carbon monoxide and particulate matter into surrounding atmosphere by the mechanically ventilated tunnel. It was found that the concentration of carbon monoxide and the particulate matter in the determinations of the air did not differ from that in the air in the immediate vicinity of the tunnel and did not differ significantly from that in the air in other parts of New York. [*"Carbon Monoxide and Particulate Matter in Air of Holland Tunnel and Metropolitan New York. Report of Investigations R.1.3585," by W. P. Yant, Edward Levy, R. R. Sayers, A. E. Brown, C. E. Traubert, H. W. Frevert, and K. L. Marshall. Published by U. S. Department of the Interior, Bureau of Mines, Washington, D. C. Mimeographed sheets; 8 x 10½ in.; 69 pages. Available from the Bureau of Mines, Washington, D. C.*]

FREON. Because of the large number of recent installations of low temperature refrigeration there has been a demand for the information on the properties of Freon-12 at low temperatures. This folder gives the physical and thermodynamic properties of Freon-12 liquid in the range of —30 to —155F. [*"Thermodynamic Properties of Freon-12, Dichlorodifluoromethane CCl_2F_2, at Low Pressures, with Addition of other Physical Properties." Published by Kinetic Chemicals, Inc., 10th and Market Streets, Wilmington, Delaware. Paper cover; 8 pages; 8½ x 11 in. Available on request from the above company.*]

INSULATION. An 8-page booklet on the use of mineral wool insulation for low temperature work. Covers material specifications, specifications for surface preparation of areas to be insulated, and individual specifications for the application of mineral wool insulation on walls, floors, ceilings, piping, fittings, etc. Twelve engineering drawings in perspective illustrate Institute-approved methods of applying mineral wool insulation, providing the necessary vapor barrier, supporting and finishing off the insulation in various applications. [*"Specifications for Mineral Wool in Low Temperature Applications." Published by the Industrial Mineral Wool Institute, 441 Lexington Avenue, New York, N. Y. Paper cover; 8½ x 11 in.; 8 pages. Copies may be secured without charge by writing to Richard L. Davis, Secretary of the Industrial Mineral Wool Association.*]

NUT STORAGE. Bulletin attempts to correlate and present the most significant results of investigations of the effects of various storage temperatures and conditions on different kinds of nuts of commercial importance. The nuts included in these studies were pecans, English walnuts, almonds, filberts, black walnuts, and macadamias. [*"Investigations on the Storage of Nuts," by R. C. Wright. Published by the U. S. Department of Agriculture, Bureau of Plant Industry, Washington, D. C. Technical Bulletin No. 770. Paper cover; 6 x 9 in.; 35 pages. Available from the U. S. Department of Agriculture, Bureau of Plant Industry, Washington, D. C. No price quoted.*]

FANS. The third edition of fan standards issued by the National Association of Fan Manufacturers. This edition embodies completely revised and rearranged data. There is included standards for Multiblade and Non-Overloading types of fans, air density ratios at various altitudes and air temperatures for use with the chart on Classes of Fans, typical specifications, abrasion, field tests of fans, and comparison tabulation of fan sizes for Multiblade and Non-Overloading fans together with minimum recommended gauges of steel for side and scroll, Class I design, is again included but revised on the basis of the new standards. [*"NAFM Standard Methods Adopted for Centrifugal Fans and Blowers", 3rd Edition. Published by the National Association of Fan Manufacturers, 5-208 General Motors Building, Detroit, Mich. Paper cover; 8½ x 11 in.; 11 pages. No charge.*]

PRIORITIES. A mimeographed, loose-leaf publication covering ABC procedure steps necessary to extend a priority order and release heating equipment. It is planned to send new sheets covering amendments to holders of this book as such amendments are made. [*"Where to Locate Heating Business and Simplified Procedure Releasing Heating Equipment Under Preference Rating Order." Published by National Radiator Corporation, 221 Central Avenue, Johnstown, Pa. 25 mimeographed sheets; 9 x 11 in. Available from above Corporation.*]

GAS FLOOR FURNACES. A commercial standard for gas floor furnaces—gravity circulating type. [*"Gas Floor Furnaces — Gravity Circulating Type." Commercial Standard CS99-42. Published by the U. S. Department of Commerce, National Bureau of Standards, Washington, D. C. Mimeographed sheets; 8 x 10½ in.; 10 pages. Available on request from the National Bureau of Standards, Washington, D. C.*]

EXHAUST VENTILATION. New Industrial Code No. 10 of the State of New York covering the control of dusts, gases and fumes in foundries, effective February 1, 1942. [*"Rules Relating to the Equipment Maintenance and Sanitation of Foundries and the Control of Dusts, Gases and Fumes in Foundries." State of New York, Department of Labor, Board of Standards and Appeals. Albany office: 11 No. Pearl Street. New York City office: 80 Centre Street. Paper cover; 5¼ x 8¼ in.; 39 pages. Price, 10 cents.*]

ASHVE GUIDE. The 1942 edition incorporates a number of changes. Included in these changes are a new chapter on the Fundamentals of Heat Transfer and revisions in the chapter on Thermodynamics of Air and Water Mixtures; Physiological Principles; Central Systems for Comfort Air Conditioning; Radiant Heating; Air Distribution; and many others. Two new charts are included, an air friction chart and the revised Mollier diagram for moist air. [*"Heating, Ventilating, Air Conditioning Guide," 1942 edition. Published by the American Society of Heating and Ventilating Engineers, 51 Madison Avenue, New York. Cloth cover; 6 x 9 in., 1256 pages, including catalog and membership section. Price, $5.*]

NEWS OF THE MONTH

Critical List Limits Radiator Heat to Multi-Family Dwellings in Defense Housing Set-Up; Heater Capacity Regulated

WASHINGTON—The War Production Board, through the Housing Priorities Branch, Division Industry Operations, issued, early in March, a Defense Housing Critical List with an effective date of February 24, 1942, with provisions for some changes in heater capacity figures to be effective April 25.

The Critical List supersedes the Defense Housing Critical List PM-1192 dated September 19, 1941, and lists materials and products which are eligible for a preference rating order granted for a housing project provided that they are used in limited quantities and for such limited uses as are specified in the list. Materials not included in the list may be used without restrictions or recommendations excepting those materials or products which are affected by Priorities Regulation No. 1. An example of this latter is copper tubing which is already affected by Priorities Regulation No. 1 and consequently does not appear in the Critical List but which can not, of course, be used without restriction.

The following summarizes the important materials and products relating to heating systems which are on the Defense Housing Critical List which are eligible for a preference rating order:

Steam and Hot Water Systems. (Can be used only for heating systems serving two or more families or extensions to existing systems to service *additional* living accommodations.) Boilers, accessories must have minimum of brass and no metal jackets. Iron and steel pipe and fittings, no metallic coating; valves, no metallic coating, 1½ in. and smaller, ferrous elsewhere except seats, discs and stems; traps for multi-family steam systems; radiators and convectors of ferrous metal, no metallic coating, no metal enclosures.

Fuel Burning Equipment. Oil burners, gas burners, hopper type stokers for multi-family systems only; oil storage tanks not to exceed 275 gal where serving 3 units or less, or not over 100 gal per dwelling unit where serving 4 dwelling units or more; oil line pumps; vent, fill, and oil line pipe and fittings of ferrous metal, no metallic coating.

Controls. Wiring and conduit as specified in electrical section; relays and solenoids, damper regulators; thermostats, limit, safety and similar controls; pressure stats, pressure reducing valves and pressure relief valves.

Flue Gas Connections. Ferrous metal breechings and smoke pipe, no metallic coating.

Water Supply. Zinc-coated ferrous pipe; cement-lined pipe; lead pipe, pipe fittings for same; 1½ in. or smaller brass valves; ferrous valves with brass parts over 1½ in.; shut-off valves; relief valves; pressure reducing valves. Pipe hangers and supports.

Hot Water Heaters and Storage Tanks. Ferrous uncoated (coated allowed where conditions require); boiler stands; no metal jackets for tank insulation; maximum tank capacity not over 20 gal per dwelling unit (except electric); direct-fired coils with storage tank; direct fired coil; fin or tube heaters with storage tank; tank type direct fired heaters; indirect coil or instantaneous heaters with storage tank. Control equipment of ferrous metal, with brass held to minimum; safety and relief valves, operating controls, gas shut-off valves.

Heating, General. Maximum net hourly output capacity in Btu per hr of heating system shall not exceed 66 times the dwelling area in sq ft or 80,000 Btu per hr per dwelling unit whichever is the smaller. The net capacity referred to here is that capacity available for heating after piping, pickup, domestic water and other similar loads are deducted, determined according to the current ASHVE *Guide*, using 70F inside and with unheated spaces calculated at outside design temperature. Dwelling area is defined as total area used for dwelling purposes contained within exterior walls at each principal floor level, excluding garage and unfinished storage space, but including only finished area of any livable space in attic or basement.

Heater Capacity. Up to April 25, 1942, maximum total hourly output capacity of heaters is to be determined by catalog ratings in effect February 24, 1942. After April 25, only equipment whose maximum net hourly capacity is rated in accordance with the following shall be eligible: gas-fired floor furnaces, 90% of AGA output rating; oil-fired floor furnaces, 90% of manufacturer's certified rating at 70% or higher efficiency; hand-fired space heaters, 90% of manufacturer's certified output rating at 60% or higher efficiency; gas-fired space heaters, 90% of AGA output rating; oil-fired space heaters, 100% of published, listed or labeled rating determined in accordance with current Commercial Standards; hand-fired pipeless furnaces, 90% of manufacturer's certified registered output at 55% or higher efficiency; oil-fired pipeless furnaces, 90% of manufacturer's certified registered output at 70% or higher efficiency; hand-fired coal gravity furnaces, 110% of Standard Gravity Code rating in square inches of leader times 136 Btu; conversion installations in gravity furnaces, 110% of Standard Gravity Code rating in square inches of leader times 136 Btu; gas furnace burner units, 75% of AGA bonnet output rating; oil furnace burner units, 75% of manufacturer's certified bonnet output at 70% or higher efficiency; hand or stoker-fired gravity furnaces with fan conversion, 100% of Standard Gravity Code leader pipe area in square inches times 180 Btu; gas-fired forced warm air furnaces, 85% of AGA output rating; oil-fired forced warm air furnaces, 85% of output rating determined by N.W.A.H. & A.C.A. Code for Testing and Rating Oil-Fired Fan-Furnace Combinations; stoker-fired burner furnace units, 85% of manufacturer's certified output rating at 70% or greater bonnet efficiency; gas-fired boilers, 65% of AGA output rating; hand-fired, stoker-fired, or oil-fired boilers, 100% of current I-B-R net rating for cast iron boilers less 12,000 net Btu per dwelling unit for domestic hot water.

While the preceding paragraph lists equipment rating method which will be eligible after April 25, equipment may be rated "*within a range of specified firing rates selected by the manufacturer if at any firing rate within that range its performance certified by the manufacturer to have been determined by test is within the limitation of the applicable code or standard specified*" in the preceding paragraph.

Hard Coal Meeting Postponed

BETHLEHEM, PA.—Rapidly changing world conditions, greater demands on the time of the technical personnel of industry, possible complications of transportation, as well as anticipated acceleration of retail activities of the anthracite industry this Spring, have lead to the postponement of the Fifth Annual Anthracite Conference at Lehigh University, originally scheduled for May 7-8.

Contractors Elect Reed

LOS ANGELES — Fred Reed of the F. D. Reed Heating Co., was re-elected president of the Heating, Piping and Air Conditioning Contractors Association of Southern California at the recent election meeting in Los Angeles.

Gas-Fired Absorption System on Display by California Utility; Building is Air Conditioned by Four Such Units

LOS ANGELES—Opened last fall, the new office building of the Southern California Gas Company is notable for having the largest gas-fueled air conditioning system on the Pacific Coast and second, the entire installation is sales slanted; that is, it is so installed that it can be used as a demonstration model in showing office building owners and managers how a gas air conditioning system functions in actual operation.

To accomplish this object the designers deviated considerably from conventional methods of installation. Some refrigeration units, for instance, are mounted with the specific object of facilitating demonstration and inspection by visitors and prospective customers. Piping, ducts, fans, cooling units, and portions of the heating coils and fans of the heating system are so mounted that salesmen of the gas company can demonstrate the operation and method of construction.

The most effective sales use of the installation has been introduced on the ground floor of the new building where one of the four refrigeration units is mounted on a concrete block in a prominent section of the sales department of the company's merchandise division. This unit is a 40-ton Williams Air-O-Matic low-pressure machine, and is raised sufficiently high above the floor to make it stand out among the other devices on display and to attract the attention of visitors to the sales room. It has also been mounted far enough from the walls to permit salesmen to conduct customers completely around the unit for a view of all sides.

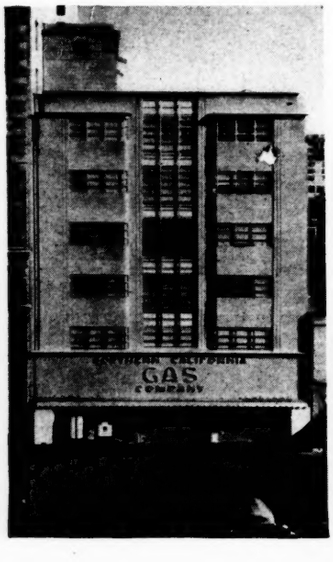
This unit is one of four similar ones which supply the cooling needs of the new building. Three others are installed in a machinery room in the adjoining old building, with interconnecting piping running to the various floors of the new structure. The total refrigeration tonnage for the new building is 160 tons. The units are of the absorption type which make it practical to utilize winter boiler heating capacity for summer air conditioning requirements. Each of the four cooling units consists of a condenser, condenser pump, absorber and heat exchanger. Four cooling towers are on the roof of the building.

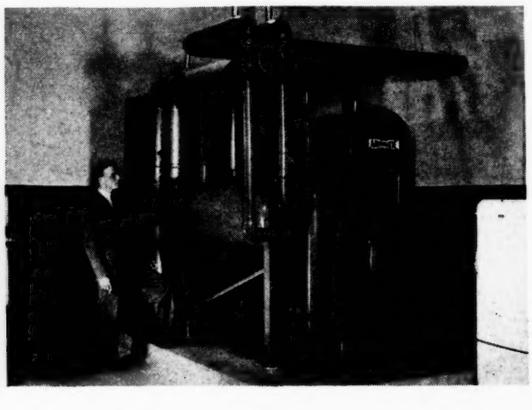
Air distribution for cool as well as warm air is handled from a machinery room on each of the five floors. A 500-gallon cold water tank for serving the four Williams refrigeration units is set up in the basement of the old building, adjacent to three Williams units and three gas boilers. Water circulates from the master tank to the four chilling units and is returned to the tank. Pumps lift the water off the line and send it to the equipment room on the respective floors, where cooling coils are installed in ducts built into furred spaces above the ceilings. Distribution from the machinery room on each floor is handled by one master fan on each floor, with air emerging into the offices and rooms through ceiling-mounted Anemostats.

Four smaller gas boilers which formerly were used to heat the 11-story main office building through a steam radiator system have been removed because they had insufficient capacity to heat both buildings. Those boilers have been replaced by three Bryant gas-burning boilers with a rating of 10,000 sq ft each. They are installed in the existing boiler room in the basement of the main building, with interconnecting heat pipes linking it with the new structure.

The architect of the new building was Robert Derrah; the general contractor, P. J. Walker & Co.; designer of the heating and cooling system, Harold Stockley, all of Los Angeles.

Contractors, all of Los Angeles, who installed various sections of the heating and cooling system were: Boilers and boiler feed pumps, Lohman Bros.; Williams Air-O-Matic refrigeration units, Johnson & Washer; heating and cooling coils, ducts, air outlets, H. S. McClelland & Co.; hot water lines, cold water lines, interconnecting piping system, Johnson & Washer.





(Left) New office building of the Southern California Gas Company adjoining the eleven-story main office building of the company. The building is interconnected at all floor levels. (Below) One of the gas-fired absorption refrigeration units on display in the building.

U.S. Needs Warm Air Men

WASHINGTON—Mechanics, supervisors and other maintenance and repair men experienced in the operation and repair of warm air heating systems are needed throughout the Army, the War Department announced March 6. Widespread use of this type of heating, especially in the larger camps and cantonments, calls for a large number of men to keep the plants in operation.

Experienced and qualified men interested in obtaining such employment should apply in writing, stating age, address and past experience. The applicant should address the District Engineer nearest or most convenient to his place of residence.

Applications may be made to the U. S. Engineers at any of the following addresses: 31 James Street, Boston, Mass.; 120 Wall Street, New York, N. Y.; 332 P. O. Building, Baltimore, Md.; 494 Spring St. N. W., Atlanta, Ga.; 232 North High Street, Columbus, Ohio; 932 New P. O. Building, Chicago, Ill.; 1709 Jackson Street, Omaha, Neb.; Fort Sam Houston, Texas, and 32 Exchange Place, Salt Lake City, Utah.

Corrosion Directory Listings

PITTSBURGH — The American Coordinating Committee on Corrosion is contemplating revision of its confidential directory of technologists actively engaged in studies on corrosion and its prevention. The Committee comprises delegates from the seventeen major technical societies together with representatives from the principal industrial research institutes and the National Bureau of Standards. Its directory currently lists some 400 investigators in a diversity of corrosion-preventive fields, selected on the basis of questionnaires circulated to the membership of the Committee's member societies. The Committee requests all persons actively engaged in corrosion researches who have not been contacted to write to the Secretary, Dr. G. H. Young, 4400 Fifth Avenue, Pittsburgh, for further details and application forms for directory listing.

Plant Engineers Plan for Raids

LOS ANGELES—At the request of the Los Angeles Fire Department and the Civilian Defense Command for Los Angeles County, the California chapter No. 2 of the National Association of Practical Refrigeration Engineers has mobilized a volunteer crew of some two dozen refrigeration, power and steam engineers to assist in repairing refrigeration and steam boiler plants which may be damaged during air raids, and in shutting off steam and ammonia lines.

A plan has been devised at conferences between a special committee of the N.A.P.R.E. chapter and Fire Chief John Alderson which provides for dividing the city into battalion districts, with standby crews assigned to every large refrigeration and boiler plant.

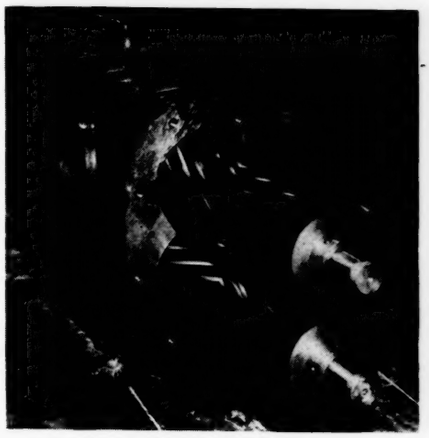
The special committee is composed of E. J. Mansfield (chairman); E. J. Gubser, chapter president; and W. R. Burnett, past-president. To supplement this directing committee, there has been appointed a working committee composed of William H. Brittin (chairman), F. R. Elliot, Heston D. Adams, P. S. Carns, and A. B. Wicks. Mr. Wicks, who is head of the Municipal Heating & Ventilating Division of the Los Angeles Building & Safety Department, will supply the committee with data concerning the location of every large boiler and refrigeration plant in the city.

The plan worked out by the committee and Fire Chief Alderson involves supplying the volunteer crews of engineers with maps indicating the location of all plants. In preparation for future emergencies, the volunteer crewmen have already begun to make studies of the plants in their respective districts in order to familiarize themselves with the locations of ammonia and steam shut-off valves, etc.

As soon as an "alert" sounds an impending blackout, the special committeemen will notify the crewmen to stand by. When report of bomb damage to a steam or refrigeration plant is flashed to the working committee, that committee will assign repair crews which are waiting at various plants in the 11 battalion districts. The crews will proceed to the plant which has been damaged.

Suggests Low Velocity Exhaust Systems

NEW YORK—In the February issue of the New York State Department of Labor District Bulletin, J. M. DallaValle of the Division of Industrial Hygiene calls attention to the advantages of using low velocity exhaust ventilating systems, particularly in view of the present scarcity of sheet metal, fans, and motors.



MICARTA GEARS FOR COMPRESSOR

Noise and vibration from 5 in. cast iron gears in the methyl-chloride rotary compressors of the Professional Building, Phoenix, Arizona, are reported to have been eliminated by the substitution of Westinghouse Micarta gears. In addition to the increase in gear life by 400% there has resulted an increased tonnage capacity with a reduction in horsepower input. Compressors to air condition the building are rated 65 tons each and handle methyl-chloride at 90 lb discharge pressure and 25 lb suction pressure. Glycerine is used as a seal between gears to trap the methyl-chloride.

Virginia May License Dealers

WASHINGTON—A bill providing for the appointment of a board for examining and certifying heating, air conditioning and plumbing contractors, prescribing fees for such examination and certification and making it unlawful to engage in heating, plumbing or air conditioning contracting without having obtained a certificate from the board and providing for penalties, has been introduced into the Senate, State of Virginia, as Bill No. 203, according to information received from William B. Henderson, executive vice-president of the Air Conditioning and Refrigerating Machinery Association.

AS HEATING AND VENTILATING goes to press Mr. Henderson writes that he has received word that the Virginia Senate adjourned March 21 without passing this bill. This means that no similar proposal will be made to the Virginia Senate for another two years.

Seasonal Index of Stoker Sales

CHICAGO—The seasonal index of stoker sales (monthly sales in per cent of yearly totals) computed from sales over the five year period 1937-41, has been calculated by the Committee of Ten Coal & Heating Industries as follows:

January, 2.91%; February, 2.75%; March, 4.25%; April, 4.55%; May, 5.96%; June, 8.08%; July, 10.16%; August, 14.30%; September, 19.00%; October, 16.32%; November, 7.10%; December, 4.62%.

Benzol Can be Used by Industry with Proper Ventilation

ALBANY, N. Y.—Contrary to allegations made in two recent newspaper articles, no prohibition against the use of benzol in industry exists in the laws of this State, Industrial Commissioner Frieda S. Miller stated March 31.

The first of these articles pointed out that benzol is suitable for industrial use "but is now barred by State regulations, which vary rather widely, are not present in some States and are particularly stringent in New York, New Jersey and Massachusetts."

The second article was more general in nature and indicated that anti-benzol regulations are in existence and that these require relaxation, and that "in many instances benzol can be substituted for toluol, but is forbidden by State regulations." In commenting, Miss Miller said:

"That benzol is a toxic substance is recognized by most if not all the authorities in the field of industrial hygiene. Its use has produced deaths among industrial workers. That such grave incidents should be prevented hardly needs to be restated. The use of benzol in industrial processes in which it is permitted to evaporate into the atmosphere requires the installation of carefully designed control equipment and the maintenance of this equipment by responsible persons so that at all times the concentration of benzol in the atmosphere is maintained at a point below its toxic level. Such maintenance must be of a very high order in most cases. Medical supervision is of great aid in determining the onset of symptomatology in persons especially susceptible to the effects of the inhalation of low concentrations of benzol.

"There are no regulations in the States of New York, Massachusetts or New Jersey which forbid the use of benzol in industry. In New York State the use of this material is safeguarded by the general requirements applicable to all potentially toxic substances. The law calls for the maintenance of conditions which do not 'tend to injure the health of the worker.' In Massachusetts the only legal requirement is that benzol containers must be labeled. This latter State recommends a limit of 75 parts of benzol per million of air, but only in an advisory manner for guiding the users of this material. The New Jersey statutes require that workers be not exposed to concentrations in excess of 100 parts of benzol per million parts of air.

"The American Standards Association has recently promulgated a maximum allowable concentration of 100 parts of benzol per million parts of air."

Woods Speaks on Defense

LOS ANGELES — Dr. B. M. Woods, member of the engineering faculty of the University of California, discussed bottlenecks of the national defense program in an address on The Place of Engineers in Defense, before the March meeting of the Southern California chapter, ASHVE.

Dr. Woods is federal coordinator of the California State Council of Defense and is active in other defense groups, including the Committee on Housing, Works and Facilities.

The speaker cited the two major bottlenecks which are retarding certain phases of national defense to be a lack of trained engineering personnel and a lack of trained managers and executives. He stressed the urgent need of a program of nationwide scope to train managers and executives. The main difficulty, he explained, deals with the fact that men who were capable managers of small plants under normal conditions find themselves out of their element in the huge plants which have trebled and quadrupled in size under the defense program.

George Hjelte, director of the Defense Council of the City of Los Angeles, addressed the chapter on The Civilian in Defense.

Recent WPB and OPA Rulings

WASHINGTON—Priority assistance for the maintenance of refrigerating equipment in stores and restaurants was granted by Amendment No. 2 to Preference Rating Order P-100, issued March 9 by the Director of Industry Operation of WPB. Under the terms of Order P-100, a preference rating of A-10 is assigned to materials for repair and maintenance of equipment for specified industries and operations. The amendment includes the maintenance of refrigerating equipment in stores and restaurants.

Following industry meetings with manufacturers, wholesalers and jobbers of plumbing fixtures and cast iron boilers and radiators, the Office of Price Administration announced March 3 that it is conducting an investigation to determine what price ceilings shall be established.

Refrigeration Talk Broadcast

NEW YORK—A short-wave broadcast over NBC in Spanish to South America on the subject of refrigeration is scheduled for April 10, according to William B. Henderson, executive vice president of the Air Conditioning & Refrigerating Machinery Association. The program was planned to be broadcast by station WRCA from 8:40 p.m. to 9 p.m. war time and station WBOS from 10:15 p.m. to 10:30 p.m. war time.

HP&ACNA Plans Meeting

NEW YORK — The Heating, Piping and Air Conditioning Contractors National Association will hold its 53rd annual convention at the Hotel Schroeder, Milwaukee, May 25-27. In view of the war the length of the convention has been cut from four days to three days.

Members at this meeting of the Association will have before them a number of serious problems. One of the most important of these is the operation of the contractor's shop today under the regulations imposed by the War Production Board. The scarcity of metal and the emphasis of the Defense Housing Division on light weight heating plants for single family homes has led the National Association to make a careful study of the design of light weight heating systems. The report on this subject will be given and the discussion will, it is hoped, bring to light further information concerning arrangement of the plant, light weight equipment, and substitutions.

How to sell repair modernization will also occupy the attention of the group. Materials for repairs are now available under two repair orders, the most effective of which is the latest, P-84. Materials for modernization in defense areas are available under defense housing priorities especially where the modernization makes building available for the shelter of more families than in its present state. Selling modernization in these defense areas will also receive attention.

How to get material will be one of the problems before the meeting, and those in touch with Washington for the Association will report on their activities.

An important report at this meeting will be from the committee on welding. The certification of welders is becoming month by month a more common problem. The discussion of standard procedure is expected to be helpful.

Heating Still Leads in Modernizing

WASHINGTON—Modernization or conversion of single-family houses continued to be the purpose of three out of every four loans reported by private financial institutions last year for insurance under Title I of the National Housing Act, Federal Housing Commissioner Abner H. Ferguson announced March 25.

Heating still led the list in the types of improvement, the major portion of the proceeds of 24.3% of the number and 20.5% of the amount of all loans reported being for heating equipment and installations. This compares with 28.7% of the number and 24.0% of the amount for 1940.

L.A. Issues Chimney Rules

LOS ANGELES — The Los Angeles Building & Safety Commission on March 10 adopted a resolution modifying the municipal provisions for chimney construction in connection with oil burning heating equipment in homes, offices and small manufacturing plants in which oil burners have been installed in increasing numbers in consequence of restrictions on the use of gas for heating.

The existing ordinance made a masonry chimney mandatory for every oil burning appliance. The new regulation permits the use of terra cotta pipe or metal-lined chimneys of cheaper construction but with equal safety factors.

The modified regulations provide that every chimney shall be constructed to comply with the following requirements:

The material composing the flue passage shall not disintegrate or soften when exposed to a temperature of not less than 1000F for not less than one hour.

The material composing the flue passage shall have an ultimate compressive strength of not less than 300 pounds per square inch.

Every chimney shall be so constructed that the temperature difference between the inner surface of the flue and the outside wall surface of the chimney shall not be less than 750F when the temperature of the air in the flue shall have been maintained for one hour at not less than 1000F, and the surrounding room temperature five feet or more from such chimney is not less than 70F.

Any such chimney shall meet such additional construction and test requirements deemed necessary by the Board.

Every such chimney shall have a clear and unobstructed flue area of not less than 12½ sq in. The least internal dimension of such flue shall be not less than four inches.

No flue in any such chimney shall have an internal cross sectional area of more than 55 sq in.

Steam Heat Represented

WASHINGTON — Formation of the vapor and vacuum steam heating specialties subcommittee of the plumbing and heating industry advisory committee was announced March 4 by the Bureau of Industry Advisory Committees.

Committee members are: John Bresnihan, William S. Haines Co.; William Jones, Barnes & Jones Mfg. Co.; B. F. Lerch, Warren-Webster & Co.; E. J. Ritchie, Sarco Company, Inc.; Lewis Smith, C. A. Dunham Co.; and C. W. Stewart, Hoffman Specialty Co.

IN PIPING *Systems* TOO!

WHEN planes bank sharply and zoom around the pylon-marked turns in air races, everyone holds his breath—for here is where surging power and flashing speed often bring destruction.

In piping systems, it's the *turns* that take the worst punishment—*wherever flow direction is changed.* TUBE-TURN fittings' exclusive construction — plus welding—insures the greatest possible strength, safety and leak-proof performance at these crucial points.

←Pressure, friction, stress and erosion are many times multiplied *wherever there is a change in flow direction.* There are TUBE-TURN fittings for *every* pipe welding need. *Write for catalog and engineering data book with complete technical information.*

TUBE-TURNS, Inc., Louisville, Ky. *Branch offices:* NEW YORK, PHILADELPHIA, CHICAGO, PITTSBURGH, CLEVELAND, TULSA, LOS ANGELES. *Distributors everywhere.*

TUBE-TURN
TRADE MARK
Welding Fittings

Dr. Winslow Discusses Human Element in Air Conditioning; Describes Experimental Work at Pierce Laboratory

CAMBRIDGE, MASS. — Dr. C.-E. A. Winslow, professor of Public Health at Yale University and director of the John B. Pierce Laboratory of Hygiene, was the guest speaker at the March 17 meeting of the Massachusetts chapter of the ASHVE. His subject was The Human Element in Air Conditioning. The speaker observed that air conditioning engineers have to satisfy all types of persons, and this is difficult because the human organism is constantly changing. He mentioned five factors to be considered in air conditioning for human comfort: metabolism; convection; radiation; evaporation and storage.

Dr. Winslow described experiments with a copper-walled booth at the Pierce Laboratory in which fans were placed near the openings to increase the air movement. This booth was irregularly rectangular in shape and the openings were also spaced irregularly, with the walls curving inward. Subjects sat unclothed with the temperature at about 40F, receiving radiant heat from the copper walls at about 120F. Because of this radiant heat they felt comfortable, although sitting thus unclothed in the low temperature. A new booth is now being tried of steel tanks, having between the two walls circulating brine or hot water, from which some interesting results are expected.

The human body maintains itself in perfect equilibrium by evaporation or perspiring. Sweat is a perfect thermal regulator, but is uncomfortable. Drafts are a very real thing in that they chill some part of the body. He spoke of an experiment in the copper booth in which, after a time, an icebag was placed against the back of the neck of the subject. There was a marked chilling, extending clear to the finger tips, and it was some time before the finger tips resumed their normal temperature and condition.

There is no scientific evidence, he said, indicating the importance of an extremely dry nose and throat, except as the dry condition might have an effect thermally. The condition depends upon absolute humidity, and not relative humidity. In other words, the amount of relative humidity is negligible in its effect upon the nose and throat. Sometimes the differential between floor and ceiling is a factor in human comfort, this differential amounting in some cases to as much as 30%. This differential condition, he said, would be remedied by panel heating. Copper would be the ideal material for radiant heat, but only for a very small cubicle. The differential would be practically the same with this type of wall in a large room, due to other factors.

In the discussion that followed, Don Edwards, General Heat & Appliance Co., said that often his installing engineers do not connect, in new houses, the humidifying equipment until some time after occupancy, figuring that the moisture in the new plaster and other material will supply the required humidity. As the walls dry out the tenant says that the air seems to contain less moisture and concludes that the humidifying equipment is no good, whereas it had never been connected.

Dry Blast for New Blast Furnace

TOLEDO—Chemical dehumidifying will be used for furnishing dry blast to the new blast furnace of the Republic Steel Corp., Alabama City, Ala. Surface Combustion, Division of General Properties Company, Inc., has been awarded the contract to supply a Kathabar moisture control system for this purpose to treat 90,000 cfm of air. The system will operate at one, two or three grains of air moisture, depending upon the season.

The system will require one 50 hp motor for power, and it is reported that no materials used in the equipment are vital to war industries. Officials have estimated that 10% increase in furnace capacity, due to the application of the dry blast, would supply the necessary materials for the equipment in one day's time. The installation will be complete in under 90 days' time.

I. U. H. A. Elects Petersen

DETROIT — At its annual meeting March 4 the Industrial Unit Heater Association elected E. W. Petersen as president; A. B. Donkersley, vice-president; and L. O. Monroe, secretary-treasurer for the ensuing year.

The Association has been cooperating with the War Production Board to standardize on the number of sizes of unit heaters to be offered to the public and the substitution of materials to help conserve copper for the war effort.

Compressor Trend Noted

LOS ANGELES—The trend in compressor design toward compact, dynamically balanced units with a minimum of vibration to meet the demand for upper-floor installation was described at the March meeting of the local chapter, National Association of Practical Refrigeration Engineers, by W. B. Barnum of the York Ice Machinery Corp.

Winther Speaks to Bakers

CHICAGO—Anker Winther, assistant general sales manager, York Ice Machinery Corporation, spoke here before the nineteenth annual meeting of the American Society of Bakery Engineers on Mechanical Refrigeration for Large and Small Bakeries.

Speaking before 1200 members of the trade directly engaged in the production of essential bakery products, Mr. Winther outlined the methods in which refrigeration and process air conditioning can assist them in maintaining uniformity and high quality in their products, and in securing high efficiency in the overall operation of their plants.

In view of the expected increased difficulties in securing replacement parts, Mr. Winther urged the bakers to have their refrigeration and air conditioning equipment vital for producing the correct temperatures and humidities required in their baking processes checked over now, thereby anticipating operating difficulties before they occur and avoiding possible future trouble at peak production periods when shut-downs would be embarrassing and costly.

Alex Dow

DETROIT — Alex Dow, who would have been 80 years old April 12, for the last two years chairman of the board, Detroit Edison Company, and President of that utility for 30 years prior to 1940, died of pneumonia March 22.

Dr. Dow, unquestionably one of the world's outstanding engineers and industrial leaders and responsible for the development of one of the country's most progressive and farsighted electric untilities, was born in Glasgow, Scotland, in 1862 and came to Detroit in 1893 as a municipal engineer. Three years later he was made vice president and general manager of the Edison Illuminating Co., predecessor of the Detroit Edison Co. In 1927 he was president of the American Society of Mechanical Engineers and held memberships in a number of other engineering organizations. He was president of the Detroit Water Board for 14 years prior to 1932 and since 1932 was district chief of Ordnance of the United States Army. He was president of the trustees of the Rackham Foundation during the planning of the Horace H. Rackham Memorial Educational Building. He was the recipient of a number of honorary degrees including a Doctor of Engineering degree from the University of Michigan, a Doctor of Science degree from Detroit University, and a Doctor of Arts degree from Wayne University.

His widow, four children, and eight grandchildren survive.

SIZING FREON REFRIGERANT LINES

The purpose of this sheet, which is to be used in conjunction with Reference Data 217-218 and 221-222, is to determine the size of, fluid velocity in, and cost of freon refrigerant lines. Additional information on the charts on this sheet is to be found on those sheets as well. The charts were designed by William Parkerson.

Since the capacity of the suction line is very sensitive to changes in suction temperature but only mildly sensitive to changes in condensing temperature, Charts II, III and IV cover three suction temperatures (30, 40 and 50F) and one condensing temperature, 105F.

Chart II appears on Sheet 217-218.

Use of Charts II, III and IV:

Example: given, a suction temperature at evaporator of 40F, suction temperature at compressor, 38F, a drop of 2F; 30 tons of refrigeration, 40 ft of straight pipe.

SOLUTION: Since the suction temperature is 40F, use Chart III. Move vertically from 30 to intersection (A) with horizontal line from 40. (A) lies between 2½ and 2⅝; use larger size. In Table 1 (Reference Data 217-218) for six elbows (average number to be used when exact number is not known) find equivalent length of elbows opposite 2⅝ to be 36.975; use 37. Add 40 to 37 and opposite 77 on equivalent length scale, vertically above (A) find (B). Since nearest larger size to (B) is 2⅝, line will be 2⅝ in O.D. Continue vertically up from (B) to (C) the intersection with the 2⅝ line and find, by interpolation, velocity to be 2850 fpm. Continue horizontal line from (B) to intersection with 2⅝ line and find (D) which indicates, by interpolation, a cost of pipe and fittings of $34. Cost is based on figures in Table X (other side this sheet). If current prices vary from these, correct accordingly and in proportion.

For sizing multiple lines, see Sheet 221-222.

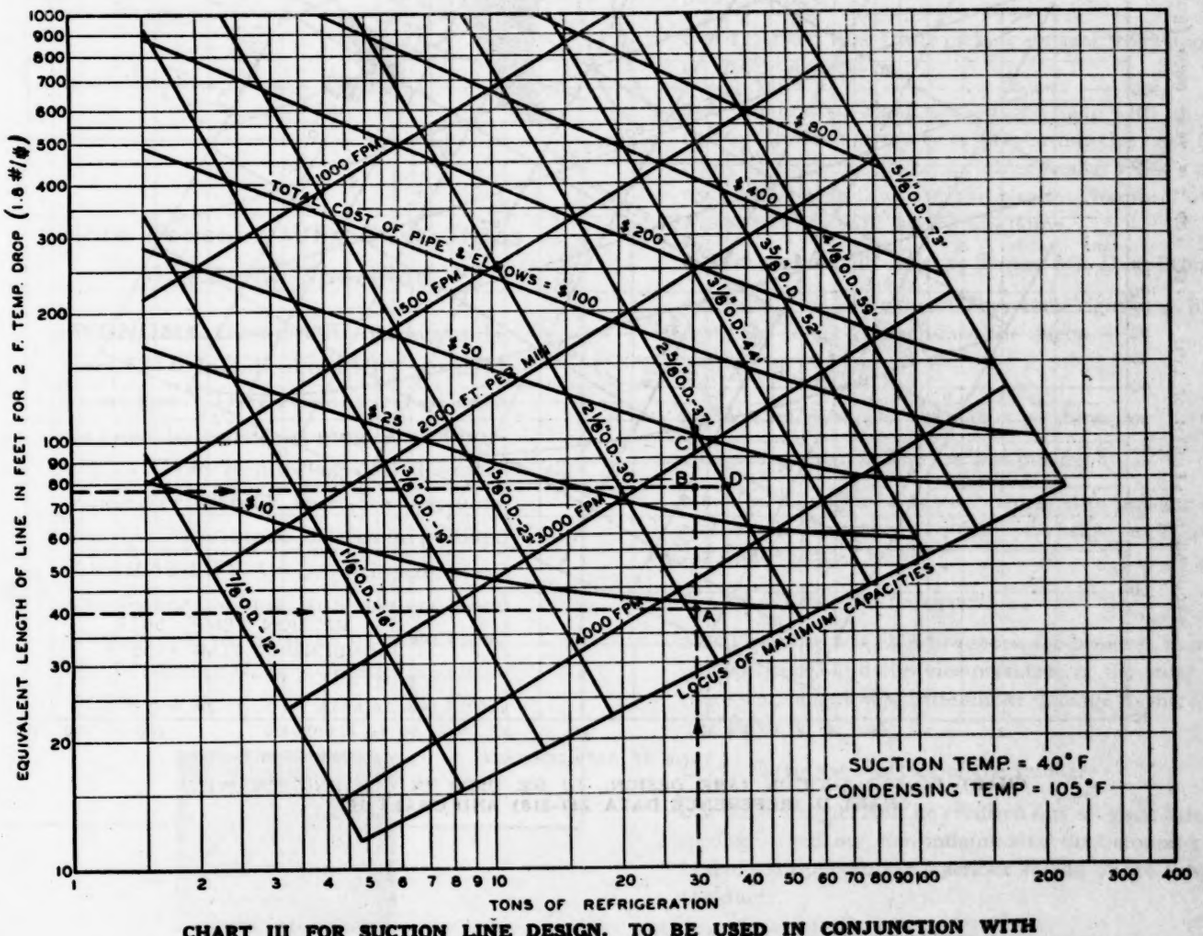


CHART III FOR SUCTION LINE DESIGN. TO BE USED IN CONJUNCTION WITH CHART IV (OTHER SIDE) AND CHART II (REFERENCE DATA 217-218).

Published by HEATING AND VENTILATING, *148 Lafayette St., New York* 4/42 *Copyright, 1942, by* THE INDUSTRIAL PRESS

H. & V.'s REFERENCE DATA—219

TABLE X.—COST OF LINES

Line Size in Inches O.D.	Net Cost of Elbows* in Dollars per Elbow	Net Cost of Six Elbows in Dollars	Equivalent Length of Six Elbows	Net Cost of Tubing† in Dollars per Foot	Equivalent Length of Pipe and Elbows Total				
					$10	$25	$50	$100	$200
⅜	0.067	0.41	4.72	0.049	201.7	509.7			
½	0.081	0.49	8.17	0.098	105.7	259.2	515.5		
⅞	0.135	0.81	11.77	0.139	78.1	186.7	367.0	727.8	
1⅛	0.248	1.49	15.37	0.188	60.8	141.0	274.2	540.4	
1⅜	0.378	2.27	18.97	0.251	49.8	109.5	209.0	408.0	806.0
1⅝	0.518	3.11	22.57	0.304	45.2	93.9	176.1	340.6	669.6
2⅛	0.742	4.45	29.77	0.465	41.7	73.7	127.4	235.6	450.6
2⅝	1.375	8.25	36.97	0.660	39.6	62.4	100.3	176.0	327.5
3⅛	2.070	12.42	44.17	0.870		58.6	87.4	144.9	259.9
3⅝	2.990	17.94	51.37	1.155		57.6	79.2	122.5	209.0
4⅛	3.920	23.52	58.57	1.447		59.6	76.9	111.5	180.5
5⅛	6.970	41.82	73.12	2.167			76.9	100.0	146.2

*Wrought Copper Elbows except 5⅛" O.D. size, which is cast brass. Prices as of 5-7-40 with usual discount applied.

†Government Type "L" copper tubing. Prices as of 5-7-40 with usual discount applied.

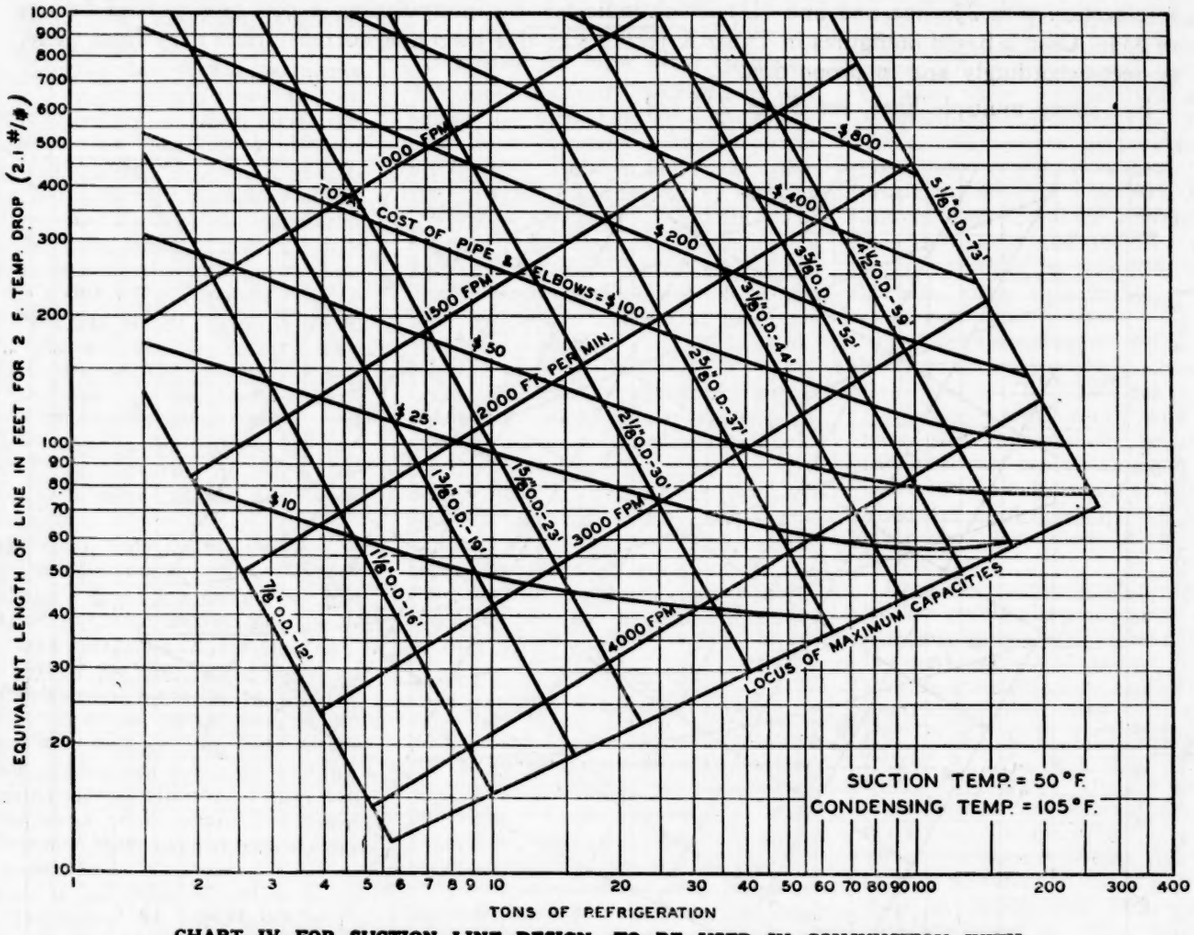


CHART IV FOR SUCTION LINE DESIGN. TO BE USED IN CONJUNCTION WITH CHART II (REFERENCE DATA 217-218) AND CHART III.

Published by Heating and Ventilating, *148 Lafayette St., New York* 4/42 *Copyright, 1942, by* The Industrial Press

Dust-Stop's story of the fire that didn't spread!

CONTRACTOR: Is it true that there was a fire in a large Midwest department store recently? (1)

DUST-STOP: Yes.

C: Tell me about it.

D-S: I was minding my own business, filtering air with 167 other Fiberglas* Dust-Stop* Air Filters. We'd been working since nine in the morning, cleaning 67,200 CFM. The fire started shortly after one o'clock. The fi....

C: Excuse me for interrupting, but what made you notice the fire?

D-S: I noticed that I was picking up soot from smoke.

C: Thank you. Go on . . .

D-S: The fire was right in the same room with us. And the forced draft action was preventing the heat from rising and setting off the sprinkler heads. What's more the control switch was in the plenum chamber, which was soon filled with smoke and flame.

C: Did you actually *see* the flames, Mr. Dust-Stop?

D-S: See them? I *felt* them! They came right at us filters and tried to get through into the ducts.

C: What did you do?

D-S: We refused to let the flames go through.

C: —and eventually the fire was put out?

D-S: Yes. The Chief Engineer managed to pull the control switch. By acting so quickly, he helped us keep the fire under control.

C: I see. Then what happened?

D-S: The store was able to reopen for business as usual in two hours. And the vice-president of the store said there was remarkably little smoke damage to merchandise because we had . . .

C: . . . taken the soot out of the smoke?

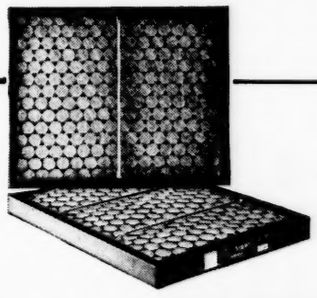
D-S: That's right. And he credited our all-glass filtering medium—and our non-inflammable dust-stopping adhesive with preventing a serious spread of fire through the ducts.

C: Thank you. You may step down now.

(1) Name on request

More Reasons Why Dust-Stops Are Being Specified

ECONOMY. **Dust-Stops cost about 1¢ per CFM to install, about 1/10¢ per CFM to replace...They can be cleaned once or twice by gentle tapping or vacuuming . . . They require no skilled supervision.** ***EFFICIENCY.*** **Dust-Stops remove nearly all "nuisance dusts and pollens.** ***AVAILABILITY.*** **Air-conditioning manufacturers, jobbers, and dealers stock Dust-Stops. Or write to us. Two sizes. No. 1 (1-inch), No. 2 (2-inch). Capacity: 2 CFM per sq. inch of area at 300 FPM.**



FIBERGLAS* DUSTOP* AIR FILTERS

*T.M.Reg. U.S. Pat. Off.

Made by Owens-Corning Fiberglas Corporation, Toledo, Ohio.
In Canada, write to Fiberglas Canada, Ltd., Oshawa, Ontario.

SIZING FREON REFRIGERANT LINES

TABLE X.—COST OF LINES

Line Size in Inches O.D.	Net Cost of Elbows* in Dollars per Elbow	Net Cost of Six Elbows in Dollars	Equivalent Length of Six Elbows	Net Cost of Tubing† in Dollars per Foot	Equivalent Length of Pipe and Elbows Total				
					$10	$25	$50	$100	$200
⅜	0.067	0.41	4.72	0.049	201.7	509.7			
½	0.081	0.49	8.17	0.098	105.7	259.2	515.5		
⅞	0.135	0.81	11.77	0.139	78.1	186.7	367.0	727.8	
1⅛	0.248	1.49	15.37	0.188	60.8	141.0	274.2	540.4	
1⅜	0.378	2.27	18.97	0.251	49.8	109.5	209.0	408.0	806.0
1⅝	0.518	3.11	22.57	0.304	45.2	93.9	176.1	340.6	669.6
2⅛	0.742	4.45	29.77	0.465	41.7	73.7	127.4	235.6	450.6
2⅝	1.375	8.25	36.97	0.660	39.6	62.4	100.3	176.0	327.5
3⅛	2.070	12.42	44.17	0.870		58.6	87.4	144.9	259.9
3⅝	2.990	17.94	51.37	1.155		57.6	79.2	122.5	209.0
4⅛	3.920	23.52	58.57	1.447		59.6	76.9	111.5	180.5
5⅛	6.970	41.82	73.12	2.167			76.9	100.0	146.2

*Wrought Copper Elbows except 5⅛" O.D. size, which is cast brass. Prices as of 5-7-40 with usual discount applied.

†Government Type "L" copper tubing. Prices as of 5-7-40 with usual discount applied.

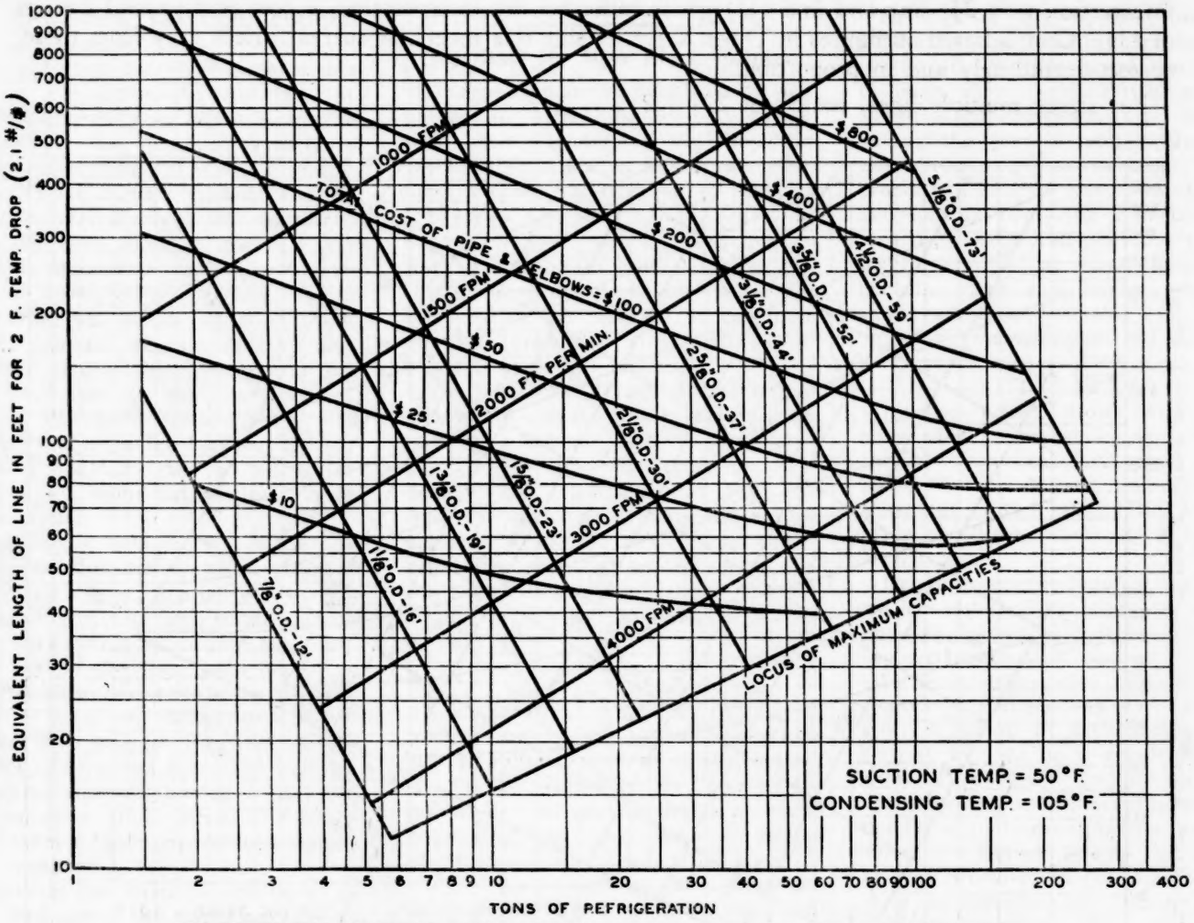


CHART IV FOR SUCTION LINE DESIGN. TO BE USED IN CONJUNCTION WITH CHART II (REFERENCE DATA 217-218) AND CHART III.

Published by Heating and Ventilating, *148 Lafayette St., New York* 4/42 *Copyright, 1942, by* The Industrial Press

Dust-Stop's story of the fire that didn't spread!

CONTRACTOR: Is it true that there was a fire in a large Midwest department store recently? (1)

DUST-STOP: Yes.

C: Tell me about it.

D-S: I was minding my own business, filtering air with 167 other Fiberglas* Dust-Stop* Air Filters. We'd been working since nine in the morning, cleaning 67,200 CFM. The fire started shortly after one o'clock. The fi....

C: Excuse me for interrupting, but what made you notice the fire?

D-S: I noticed that I was picking up soot from smoke.

C: Thank you. Go on . . .

D-S: The fire was right in the same room with us. And the forced draft action was preventing the heat from rising and setting off the sprinkler heads. What's more the control switch was in the plenum chamber, which was soon filled with smoke and flame.

C: Did you actually *see* the flames, Mr. Dust-Stop?

D-S: See them? I *felt* them! They came right at us filters and tried to get through into the ducts.

C: What did you do?

D-S: We refused to let the flames go through.

C: —and eventually the fire was put out?

D-S: Yes. The Chief Engineer managed to pull the control switch. By acting so quickly, he helped us keep the fire under control.

C: I see. Then what happened?

D-S: The store was able to reopen for business as usual in two hours. And the vice-president of the store said there was remarkably little smoke damage to merchandise because we had . . .

C: . . . taken the soot out of the smoke?

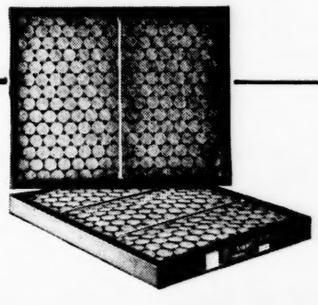
D-S: That's right. And he credited our all-glass filtering medium—and our non-inflammable dust-stopping adhesive with preventing a serious spread of fire through the ducts.

C: Thank you. You may step down now.

(1) Name on request

More Reasons Why Dust-Stops Are Being Specified

ECONOMY. **Dust-Stops cost about 1¢ per CFM to install, about 1/10¢ per CFM to replace...They can be cleaned once or twice by gentle tapping or vacuuming . . . They require no skilled supervision.** ***EFFICIENCY.*** **Dust-Stops remove nearly all "nuisance dusts and pollens.** ***AVAILABILITY.*** **Air-conditioning manufacturers, jobbers, and dealers stock Dust-Stops. Or write to us. Two sizes. No. 1 (1-inch), No. 2 (2-inch). Capacity: 2 CFM per sq. inch of area at 300 FPM.**



FIBERGLAS* DUSTOP* AIR FILTERS

*T.M.Reg. U.S. Pat. Off.

Made by Owens-Corning Fiberglas Corporation, Toledo, Ohio.
In Canada, write to Fiberglas Canada, Ltd., Oshawa, Ontario.

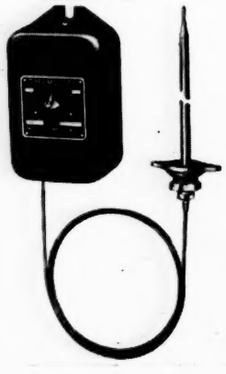
NEW EQUIPMENT

Owens-Corning Insulation Board

NAME—Asphalt enclosed AE board.
PURPOSE—For low temperature and roof insulation.
FEATURES—AE board is made of glass fibers compressed to a density of six pounds to the cubic foot and enclosed in a sheath of durable, high melting asphalt. It is said to have a heat conductivity of 0.265 Btu per sq ft per hr per F per inch thickness at a mean temperature of 60F. Manufacturer states that it can be used for roof insulation for industrial buildings, both for reducing the passage of heat and for eliminating condensation. It is also useful for insulation of low temperature spaces. Manufacturer states that when the board was exposed in a humidity cabinet at 70F and 65% relative humidity the moisture pick-up from previously dry conditions was 0.064% by weight. The asphalt coating is thoroughly sanded to prevent adhesion of the blocks to one another during shipment and storage.
SIZES—12 x 36 in. in thicknesses of 1, 1½ and 2 in. Special size pieces can be made on the job by cutting the board to size and sealing the cut edges with hot asphalt. Material can be sawed with an ordinary wood saw if the blade is lubricated with kerosene.
MADE BY—*Owens-Corning Fiberglas Corporation, Toledo, Ohio.*

Barber-Colman Microtherm

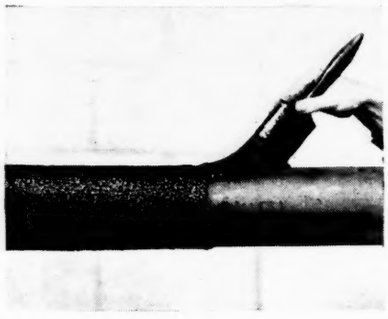
NAME—Remote bulb Microtherm.
PURPOSE—For control of temperatures in ducts, tanks, liquid lines, kettles, etc.
FEATURES—A liquid filled remote-bulb proportioning thermostat used when it is desirable to mount the mechanism where it is readily accessible, free from vibration, dust, dirt, and extreme temperatures. Available with or without armored tubing.
LITERATURE AVAILABLE—Bulletin F-1420-3.
MADE BY—*Barber-Colman Company, Rockford, Ill.*



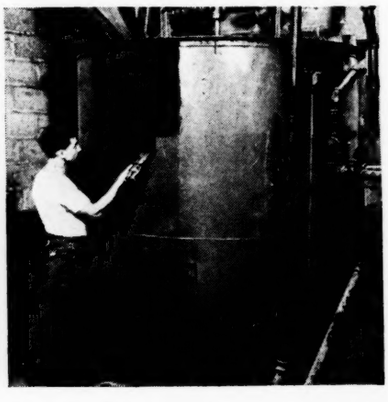
Cambridge pH Recorder

NAME—Multi-Point pH recorder.
PURPOSE—For simultaneous recording of pH values at various points in a fluid-flow system.
FEATURES—Manufacturer states that this instrument makes it possible to provide a continuous before and after picture of pH which enables the operator to continuously see the effectiveness of the process in use. The new instrument is said to incorporate an outstanding advance in circuit design that permits installation of the electrodes at separate and independent sampling points in the plant. They are connected electrically to the recorder which may be a considerable distance away.
MADE BY—*Cambridge Instrument Company, Inc., Grand Central Terminal, New York.*

Mortell's Cork Coating



NAME—NoDrip.
PURPOSE—For preventing condensation drip.
FEATURES—This material is a plastic cork coating which may be applied to pipes, walls, ceilings, or tanks with an ordinary paint brush. The coating is spread ¼ in. thick over the material and it may be painted in any color. Material is said to be odorless, vermin proof, and self bonding. One gallon is said to cover six square feet, ¼ in. thick.
SIZES—Available in 1 and 5 gallon cans and also in 55 gallon drums.
MADE BY—*J. W. Mortell Company, Kankakee, Illinois.*

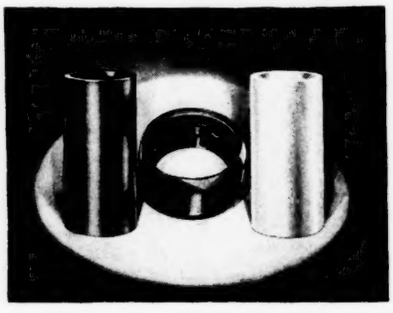


Oil Treatment

NAME—Perolin fuel oil treatment.
PURPOSE—To dissolve and eliminate sludge in fuel tanks, to keep fuel lines clean and to reduce carbon and soot on burner and in boiler.
FEATURES—Product is a fluid sold direct to large users, 1 qt being applied with every 1000 gal of oil. In addition to dissolving sludge it is said to emulsify any water that gets into the system.
SIZES AND CAPACITIES—Sold in bulk or in 1 gal packages.
MADE BY—*Perolin Company of New York, Inc., 551 Fifth Ave., New York.*

Roxite Cement-Asbestos Pipe

NAME—Roxite cement-asbestos pipe.
PURPOSE—Designed for handling a wide range of mildly corrosive solutions, for transporting processing water which must be kept free from metallic contamination, for handling fumes and gases from ventilating ducts and stacks, and similar applications.
FEATURES—Manufactured by a high pressure process so that pipe has a high density and great mechanical strength. Pipe is coupled by Flexlock sleeves and fittings, which does away with need for special treatment or threading of the pipe ends.
SIZES AND CAPACITIES—Available in two types: standard coating consists of an internal and external synthetic resin finish having a thickness of about 1/64 in. This coating is tough and durable and insures adequate protection for a great many corrosive conditions, including resistance to non-oxidizing acids; for more severe service, pipe can be lined with Tygon corrosion-resistant lining material with an effective thickness of ⅛ in. This lining thickness offers high resistance to abrasion along with immunity against most corrosive chemicals, with the exception of glacial acetic, concentrated sulphuric and chlorinated solvents. Available in any length up to 14 ft in sizes from ¾ in. up to 8 in. inside diameter. Larger sizes on special order. Standard fittings available. Satisfactory for working pressure up to 150 lb per sq in.
MADE BY—*The United States Stoneware Co., Akron, Ohio.*



Lasting Ductwork brings warmth to Army trainees

Photo by U. S. Army Signal Corps

BETHLEHEM GALVANIZED STEEL SHEETS

In building the ducts, vents and stacks in the U. S. Army cantonment shown here, as in many another job of the kind, the sheet-metal contractor used Bethlehem Galvanized Steel Sheets because they have the easy-forming qualities that make for rapid, efficient sheet-metal work. Bethlehem Sheets, moreover, are protected from rust by a tight coating of pure zinc that stubbornly resists flaking and provides a tough defense. That means longer life for sheets and lasting ductwork to bring warmth to Army trainees.

BETHLEHEM STEEL

BETHLEHEM STEEL COMPANY

Roxaneal

NAME—Roxaneal.
PURPOSE—A glass protector to prevent broken glass from flying and intended especially for reducing personal injury hazards in case of bomb blast concussions and air raids.
FEATURES—Protector is water-white, transparent liquid that prevents broken glass from flying. It is not claimed to stop glass from fracturing, but tests have proved that it will keep broken glass in place thus preventing dangerous glass splinters from flying. It is available in clear, transparent form which does not obstruct vision or light, and also is available in blackout type. It may be applied by brushing material on interior of clean glass. Windows may then be cleaned, when necessary, with mild soap solutions without affecting strength of the protective film. After emergency is over, is easily removed either by peeling off with razor blade, or by washing off with solvents.
MADE BY—*Roxalin Flexible Finishes, Inc., Elizabeth, N. J.*

Metalloy Aluminum Solder

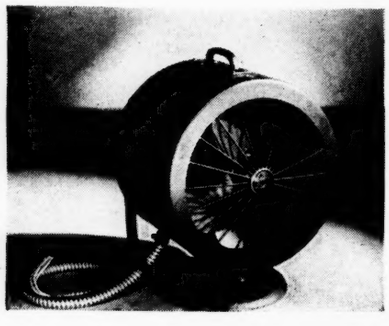
NAME—Galvalloy.
PURPOSE—For soldering aluminum or aluminum alloys without the use of flux.
FEATURES—Manufacturer states that a perfect soldering bond with aluminum or aluminum alloys without any flux can be obtained with this new metal alloy. It is also said to bond practically all types of metals which allow the bonding of aluminum or aluminum alloys to these metals. In using the material the surface to be coated or soldered is heated with a welding torch to about 600F. Then a stick of alloy is applied directly to the heated surface. A stiff wire brush is applied until a bright finish is secured. If a heavy deposit is desired, after the initial bond more material is applied and agitated with a paddle or wire brush until the required thickness is obtained. Manufacturer states that the alloy can be used in foundries for filling blow holes or defects. Also may be used as a protective coating on welded seams or other areas where a non-corrosive coating is needed. It is claimed that under oceanic atmospheres after 4000 hours of exposure no discoloration or corrosion appeared.
MADE BY—*Metalloy Company, Box 3093, Terminal Annex, Los Angeles, Calif.*

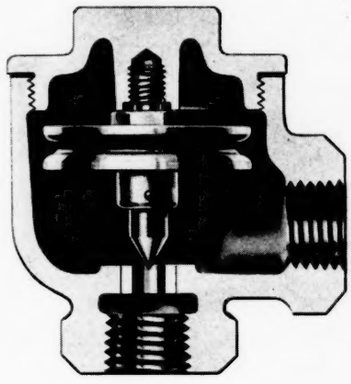
Uni-Flo Deflectrol

NAME—Uni-Flo Deflectrol.
PURPOSE—For use in trunk ducts to control accurately volume of air deflected into branch ducts and to provide straight and uniform flow in each branch.
FEATURES—Consists of a section of Elturn core material mounted in hinged frame, same size as branch duct, and having hood extension to prevent leakage around unit. In short branches prevents piling up and distortion of air stream; junctions with main duct may be of square construction so as to preserve space and simplify duct lay-out work.
MADE BY—*Barber-Colman Company, Rockford, Ill.*

Westinghouse Unit Heater

NAME—Westinghouse fan-type all electric unit heater.
PURPOSE—For general use in offices and stores.
FEATURES—Heater cylindrical in shape with bracket designed for vertical adjustment. Overall dimensions approximately 20 by 16 by 15 in. Powered by a ⅛-hp motor with resilient mounting, a four-blade fan operates at 1725 rpm to put out 615 cfm of air at a velocity of 785 feet per minute. Corox heating element. To prevent overheating, temperature limit switch is connected in the control circuit of the contactor. Maximum air temperature rises based on a 70F inlet temperature are 45 and 60F in the 5- and 7½-kw ratings. Mounting can be made on wall, ceiling, and floor.
SIZES AND CAPACITIES—Available in 5- and 7½-kw sizes, 230 volts, 50/60 cycles, with output of 17,060 and 25,590 btu per hr., respectively. These sizes are an extension of the 2-, 3-, and 4-kw heaters announced a year ago.
MADE BY—*Westinghouse Electric and Manufacturing Company, East Pittsburgh, Pa.*





Webster Radiator Trap

NAME—Old Ironsides.
PURPOSE—Radiator trap designed especially to meet war requirements.
FEATURES—The outstanding feature of this trap is that needed brass is conserved by the use of an iron body and cap and the elimination of a union nut and nipple. The elimination of the nut and nipple also saves machine tool hours. Manufacturer states that this trap is equal in operating efficiency to earlier Webster traps and that it costs no more than the brass equivalent which it supersedes. This trap has the same double diaphragm of Monel metal or phosphor bronze and the same 60° cone valve piece and sharp edged seat as other Webster traps. It is fully compensated for pressures and is said to function efficiently at all pressures within the operating range. The inlet tapping of the trap is a left-hand thread which is to be connected with the radiator or other unit by using a right and left-hand pipe nipple. Manufacturer states that the slight extra effort involved in making the connection with a right and left hand nipple results in a considerable saving of brass, machine tool hours and cost and that thousands of radiators were installed in this way years ago. Where it is desired to use a union in connecting the trap and the radiator, right hand inlet tappings are available on special order. The outlet tap will, in all cases, be standard right hand thread. Nickel and other plating has been eliminated and the trap is furnished in a natural finish for painting after installation.
SIZES AVAILABLE—One-half inch angle body only with female tappings both ends. Valve is designed for low pressure vapor and vacuum steam heating service. The maximum pressure is 25 lb per sq in. Manufacturer states that conservative ratings for the trap will vary from 55 sq ft EDR at 1/10 of a lb per sq in. pressure difference across the trap to 840 sq ft EDR at 25 lb pressure difference.
LITERATURE—Bulletin B-703.
MADE BY—*Warren Webster & Company, Camden, New Jersey.*

"Noiseless"

AIR CONDITIONED COMFORT at FINKE FURNITURE STORE *because of*

Careyduct
THE ALL-ASBESTOS INSULATED DUCT

CONSERVES SHEET METAL for WAR WORK

FINKE'S, at Evansville, Indiana, was the first completely air-conditioned furniture store in this progressive city. Desiring the best in modern air conditioning, the management decided for CAREYDUCT, the all-asbestos duct that combines both duct and insulation in strong, fireproof units.

CAREYDUCT is a natural sound absorber and non-conductor of sound. Outstandingly superior where fan noise, metallic "cracking," or outside noises are objectionable.

Because CAREYDUCT hushes noise, it permits smaller sizes with higher velocities . . solves many difficult problems where space is limited. Its smooth surface and flush joints reduce friction BELOW that of best metal construction. Eliminates costly shop fabrication; fittings economically made on job.

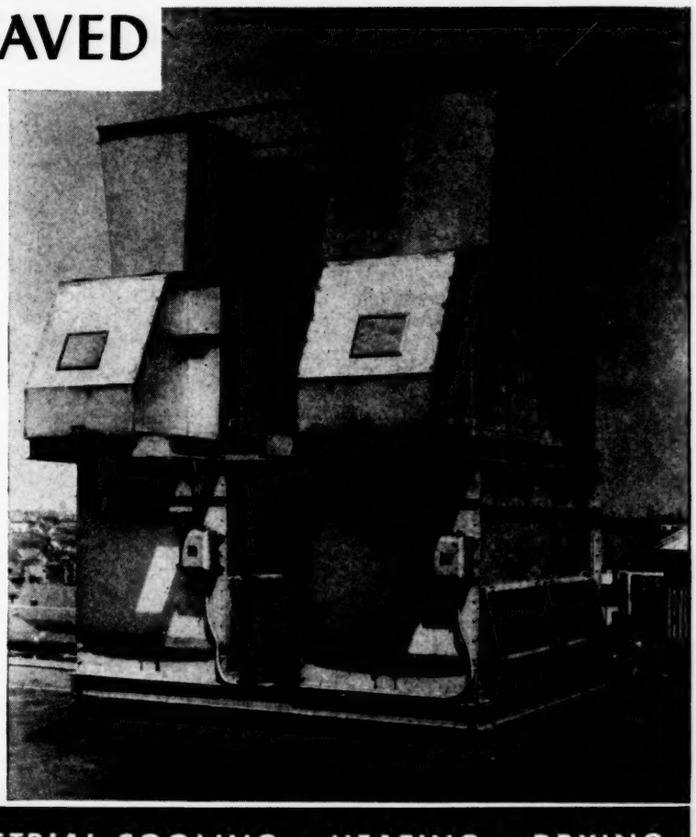
CAREYDUCT conserves steel for defense purposes. With over 30 important advantages, and saving 6 different labor operations, *CAREYDUCT costs LESS than insulated metal duct.*

Wherever you find management that wants tops in air-conditioning, there's the place to specify a CAREYDUCT job. Write today for all the facts. Build business with CAREYDUCT. Address Dept. 49.

The Philip Carey Mfg. Company *Dependable Products Since 1873* **Lockland, Cincinnati, Ohio**

IN CANADA: THE PHILIP CAREY COMPANY, LTD., OFFICE AND FACTORY, LENNOXVILLE, P. Q.

15% to 35% of POWER SAVED



This user of the NIAGARA PATENTED DUO PASS EVAPORATIVE CONDENSER not only saves the cost of 16,000 gallons of water per hour in peak load seasons, but also has the advantage of a net year 'round power saving of 15% to 35% in spite of addition to the previous connected load.

The patented NIAGARA DUO PASS lowers condensing temperatures, prevents scale formation, assures that the savings of evaporative condensing will be maintained for many more years than with ordinary equipment.

NIAGARA BLOWER COMPANY

Dept. HV-42

6 E. 45th Street, New York City
37 W. Van Buren St., Chicago, Ill.
Fourth & Cherry Bldg., Seattle, Wash.
673 Ontario St., Buffalo, N. Y.

Sales Engineers in Principal Cities

NIAGARA *INDUSTRIAL* COOLING • HEATING • DRYING
HUMIDIFYING • AIR ENGINEERING *EQUIPMENT*

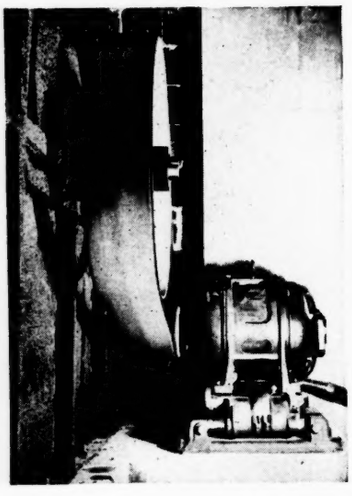
New Equipment

Evertite Chamber

NAME—Evertite chamber.
PURPOSE — For installation on oil storage tanks of the pressure type, to provide simple method of applying a blanket of fire-smothering foam to burning oil surfaces.
FEATURES—Derives its name from the fact that inspection cap can be removed, and a sealing diaphragm inspected, without releasing tank pressure. Vapor-proof glass diaphragm is so installed as to prevent vapors in tanks from entering body of mixing chamber, from entering and condensing in chemical solution lines, or from escaping to air when bottom or top plate, or inspection cap, are removed. Diaphragm, glazed in metal frame, holds gas tank pressure, yet ruptures fully under foam pressure at time of fire, allowing free access of foam blanket to burning surface. Diaphragms readily replaced. Chamber is of expansion type design, with increasing cross-sectional area to insure intimate mixing of chemical solutions, efficient formation of foam, and low velocity delivery. A and B solution inlets at bottom of chamber impinge within baffle, assuring thorough mixing. Chamber is of sturdy construction. Body is of sheet steel.
MADE BY—*American-LaFrance-Foamite Corporation, Elmira, N. Y.*

Belting Transmission

NAME—Tannate leather belted Rockwood short center drive.
PURPOSES — Automatic maintenance of correct belt tension.
FEATURES—Operates with short centers. Can be used for group or individual drives. Drives from the floor, wall, ceiling, vertically, or mounted on the machine.
SIZES AND CAPACITIES — Tannate belt to 2,000 hp, Rockwood base, fractional horsepower to 400 hp and over.
LITERATURE AVAILABLE — Data book and folder.
MADE BY—*Leather belting by J. E. Rhoads & Sons, Philadelphia. Rockwood motor base by Rockwood Mfg. Co.*



Signalling Controller

NAME—Leeds & Northrup signalling controller.
PURPOSE — Tests condensate purity continuously with signal light to show whether condensate is above specified minimum purity.
FEATURES — Used where indicating and recording of condensate purity are not needed, equipment tests condensate purity continuously. Self-contained signal lights show whether condensate is above specified minimum purity and is safe to use again, or whether it is below this limit and should be diverted to waste. Instrument can operate external warning bells or lights, or, can provide automatic two-position control by regulating motor-driven valve in condensate line to dump impure condensate.
MADE BY — *Leeds & Northrup Company, 4934 Stenton Ave., Philadelphia, Pa.*

National Series 1 Boiler

NAME — National No. 1 series cast-iron boiler.
PURPOSE—For small homes.
FEATURES—Available in two types, for hand-fired coal or for oil. Boilers are of wet base type. Available with or without jacket.
SIZES AND CAPACITIES — Hand-fired boiler in four sizes with capacities from 41,000 to 83,000 Btu per hr. Oil-fired boilers available in four sizes with capacities from 55,000 to 98,000 Btu per hr, all I-B-R ratings.
MADE BY — *The National Radiator Co., Johnstown, Pa.*

Maas & Waldstein Luminous Paint

NAME—Durad luminous paint.
PURPOSE—For making objects visible in the dark.
FEATURES—Manufacturer states that this paint owes its luminosity to a substance which re-radiates light. Is said to contain no toxic materials and will glow for about 20 hours after it has been exposed to light for a few minutes.
MADE BY—*Maas & Waldstein Company, 438 Riverside Avenue, Newark, N. J.*

Plastic Fan Blades

NAME — Torrington propeller fan blades made of plastic.
PURPOSE—Plastic is alternate material for aluminum and company reports plastic was being studied in its laboratories for this use even prior to current restrictions on aluminum.
FEATURES — Plastic propeller blade is light in weight, non-resonant and non-corrosive. Blades can not be formed but are given some curvature by the use of specially formed spider. Tests run in laboratory, included 80,000 stops and starts at the rate of 13 per minute, with the blade attaining a top speed of 2,400 rpm; 20½ hours continuous operation at speeds from 2,500 to 5,700 rpm; and 60 hours intermittent operation in a temperature of 178F. While blades are not ideal, company reports they are a satisfactory temporary expedient during the present emergency.
SIZES AND CAPACITIES — Limited to 10, 12, 14 and 16 in. in standard 4-blade series at the present.
MADE BY—*Torrington Mfg. Co., Torrington, Conn.*

Remote Valve Control

NAME—Foxboro remote valve control unit.
PURPOSE—For manually controlling remote valves, dampers and other pneumatically-operated equipment.
FEATURES—In appearance unit harmonizes with rectangular case in which company's recording and controlling instruments are now available. When unit is flush-mounted, front surface is 7/16 in. from the surface of instrument panel, and as setting knob and pressure indicator are recessed, there are no protruding parts. Specifically designed for dead end service, valve control unit will hold reduced pressures to values within very narrow limits. It is practical for operation over distances as great as 1000 feet.
LITERATURE AVAILABLE—Bulletin A-276.
MADE BY — *The Foxboro Company, Foxboro, Mass.*

De-Sta-Co
Blower Wheel Housings

of Standard Dimensions

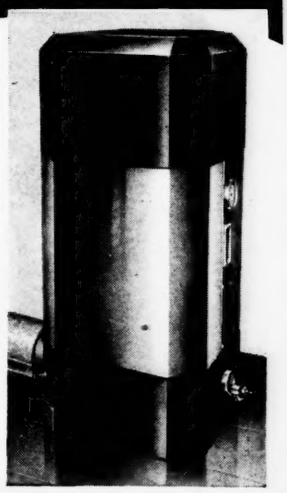
Made in sizes to fit 4½, 5, 6, 7½ and 9 inch wheels and in widths to suit single or double inlet wheels . . . also individual parts for your own assembly.

De-Sta-Co housings are engineered for maximum efficiency and quietness in operation . . . neatly finished. Send for "De-Sta-Co Blower Housings" bulletin; gives complete information, including essential dimensions.

DETROIT STAMPING CO.
Established Over 25 Years
375 Midland Ave • Detroit, Mich.

A MIGHTY MIDGET . .

• for heating
• for hot water



DEPENDABLE steam or hot water heating of anything from a small home to a small apartment building, and plenty of hot water, too, is given by any one of 9 sizes of this compact oil-burning boiler-burner unit. It's the baby of the famous Johnson line of heating devices — youngest and smallest — but its popularity is already nationwide. And you don't need a whole basement room for it. One sq. yd. of floor space, often above ground, will do.

ECONOLUX

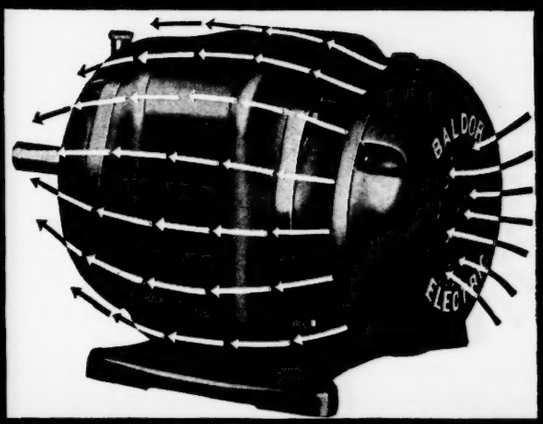
FOR today's needs — residential, defense, industrial! Thousands of heating contractors, architects, builders, home-owners say—it's the answer. Midget in size and cost—mighty in service!

JOHNSON CAN HELP YOU . . . WRITE TO GET FULL DETAILS

FREE COMPLETE SPECIFICATIONS

S. T. JOHNSON CO.
940 Arlington Avenue • Oakland Calif.
401 N. Broad Street • Philadelphia Pa.

BALDOR
BETTER MOTORS



Illustrating forced air-movement over entire exterior of motor frame

Streamcooled DESIGN
—a Superior BALDOR feature

BALDOR Streamcooled design provides totally enclosed motors with an unfailing, CAN'T CLOG cooling system that assures permanent cool-running performance.

These are ball-bearing motors, with glass insulation to withstand higher temperatures and provide more H. P. in smaller frame sizes.

These and many other features at NO EXTRA COST to you.

BALDOR ELECTRIC COMPANY, *St. Louis*
Motor Specialists for more than 21 years
Representatives in Principal Cities

BALDOR ELECTRIC

Number of Degree-Days for February, 1942

City	Degree-Days Feb. 1941	Degree-Days Feb. 1942	Degree-Days Season 1941-42
Albany, N. Y.	1166	1237	4912
Alpena, Mich.	1244	1287	5168
Atlanta, Ga.	709	712	2366
Atlantic City, N. J.	919	924	3254
Baker, Ore.	836	1029	5100
Baltimore, Md.	866	855	2993
Binghamton, N. Y.	1169	1198	4545
Birmingham, Ala.	633	611	2151
Bismarck, N. D.	1389	1353	5903
Boise, Idaho	715	939	4587
Boston, Mass.	998	1058	4012
Buffalo, N. Y.	1157	1234	4559
Burlington, Iowa	—	1077	3251
Burlington, Vt.	1244	1361	5574
Cairo, Ill.	829	792	3049
Canton, N. Y.	1303	1397	5752
Charles City, Iowa	1348	1238	5126
Charlotte, N. C.	700	697	2376
Chattanooga, Tenn.	761	770	2856
Cheyenne, Wyo.	919	1224	5311
Chicago, Ill.	1104	1076	4157
Cincinnati, Ohio	968	967	3559
Cleveland, Ohio	1076	1109	4028
Columbia, Mo.	918	909	3556
Columbus, Ohio	1016	1018	3788
Concord, N. H.	1113	1235	5246
Concordia, Kan.	984	981	3984
Davenport, Iowa	1155	1107	4293
Dayton, Ohio	1033	1021	3805
Denver, Colo.	778	1138	4404
Des Moines, Iowa	1137	1128	4456
Detroit, Mich.	1111	1186	4362
Dodge City, Kan.	853	932	3735
Dubuque, Iowa	1198	1142	4575
Duluth, Minn.	1419	1369	6027
Eastport, Me.	1108	1224	5349
Elkins, W. Va.	1096	1083	4058
El Paso, Tex.	333	473	1955
Erie, Pa.	1102	1159	4136
Escanaba, Mich.	1243	1263	5380
Evansville, Ind.	935	886	3505
Fort Smith, Ark.	668	647	2618
Fort Wayne, Ind.	1114	1181	4438
Fort Worth, Tex.	515	476	2011
Grand Rapids, Mich.	1131	1180	4385
Green Bay, Wis.	1284	1260	5095
Greensboro, N. C.	811	797	2963
Harrisburg, Pa.	991	985	3775
Hartford, Conn.	1036	1088	4354
Helena, Mont.	1040	1387	6372
Huron, S. D.	1345	1249	5214
Indianapolis, Ind.	1033	1016	3738
Ithaca, N. Y.	1158	1224	4624
Kansas City, Mo.	931	923	3525
Kewanee, Ill.	1089	1020	4071
Knoxville, Tenn.	792	807	2853
La Crosse, Wis.	1295	1229	4949
Lander, Wyo.	1107	1439	6331
Lansing, Mich.	1166	1242	4694
Lewiston, Maine	1084	1247	5421
Lincoln, Neb.	1055	1082	4292
Little Rock, Ark.	671	648	2519
Los Angeles, Calif.	175	259	870
Louisville, Ky.	903	891	3262
Lynchburg, Va.	806	789	2864
Madison, Wis.	1271	1248	4917
Marquette, Mich.	1217	1251	5363
Memphis, Tenn.	700	699	2750
Milwaukee, Wis.	1180	1200	4855
Minneapolis, Minn.	1408	1241	5254
Nantucket, Mass.	937	1019	3785
Nashville, Tenn.	794	765	2828
New Haven, Conn.	985	1035	3926
New Orleans, La.	331	348	1157
New York, N. Y.	941	993	3581
Nome, Alaska*	1860	1415	5979
Norfolk, Va.	753	732	2364
Northfield, Vt.	1297	1392	5838
North Platte, Neb.	974	1130	4646
Oklahoma City, Okla.	689	679	2762
Omaha, Neb.	1085	1132	4493
Oswego, N. Y.	1154	1208	4715
Parkersburg, W. Va.	972	970	3567
Peoria, Ill.	1105	1072	4141
Philadelphia, Pa.	929	933	3333
Pittsburgh, Pa	1029	1027	3680
Pocatello, Idaho	916	1304	5677
Portland, Me.	1138	1211	5170
Portland, Ore.	450	583	2975
Providence, R. I.	974	1030	4017
Pueblo, Colo.	781	1033	4405
Raleigh, N. C.	736	727	2471
Reading, Pa.	982	984	3679
Reno, Nev.	648	844	4146
Richmond, Va.	806	786	2839
Rochester, N. Y.	1189	1253	4714
Roseburg, Ore.	476	582	2819
St. Joseph, Mo.	970	990	3869
St. Louis, Mo.	904	868	3315
Salt Lake City, Utah	702	1062	4612
Sandusky, Ohio	1066	1120	4056
San Francisco, Calif.	269	327	1547
Sault Ste. Marie, Mich.	1307	1407	6062
Scranton, Pa.	1105	1146	4307
Seattle, Wash.	469	589	2909
Sioux City, Iowa	1203	1213	4929
Spokane, Wash.	746	951	4805
Springfield, Ill.	1006	981	3747
Springfield, Mo.	870	864	3524
Syracuse, N. Y.	1212	1249	4748
Tacoma, Wash.	529	623	3191
Terre Haute, Ind.	999	968	3647
Toledo, Ohio	1097	1166	4252
Trenton, N. J.	968	977	3642
Utica, N. Y.	1274	1305	5000
Washington, D. C.	871	861	3103
Wichita, Kan.	852	874	3528
Yakima, Wash.	713	777	4184

Figures in this table, with four exceptions, are calculated by HEATING AND VENTILATING from local weather bureau reports. Exceptions are Utica, Lewiston, Kewanee, and Sioux City, figures for which are furnished through the courtesy of R. C. Edmunds, Manager of Coke Sales, Central New York Power Corp., Utica, N. Y.; Norman E. Ross, Bursar, Bates College, Lewiston, Me.; J. M. Hartman, Engineering Department, Kewanee Boiler Corp., Kewanee, Ill., and Alfred R. Wagstaff, Engineer, Sioux City Foundry and Boiler Co., Sioux City, Iowa, respectively. HEATING AND VENTILATING will welcome an opportunity to make arrangements with readers who are keeping degree-day records over a period for important communities not listed above in order to make such data available to the industry.

*The figures for Nome, Alaska, are for January, 1941; January, 1942; and Season 1941-42 to January 31, respectively.

Specified FOR THE BIG JOBS

Put yourself in the place of the engineers who specified the steam traps pictured above, for their company's own huge office building, fully air conditioned.

To be secure in your position, YOU TOO would specify Sarco. Not merely because these products were built in the newest, biggest and best plant devoted exclusively to steam traps and control; and not because every Sarco user you talked to said you would make no mistake. It would be because—from every angle—after weeks of consideration you knew that Sarco Steam Traps would substantiate your judgment.

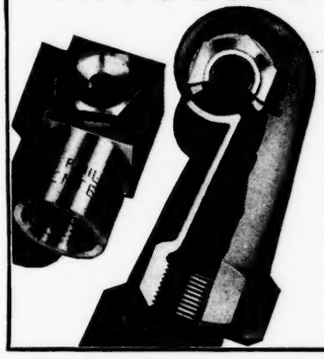
Write for Catalog Nos. 250, 38 and 350.

119

SARCO SAVES STEAM

SARCO COMPANY, INC.
475 Fifth Avenue, New York, N. Y.
SARCO CANADA LTD., FEDERAL BLDG., TORONTO, ONT.

YARWAY INVOLUTE NOZZLES

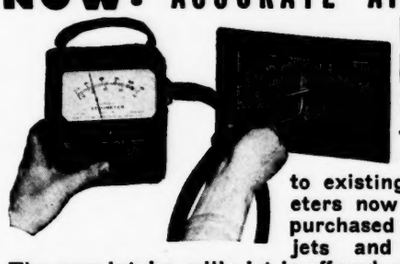


The preference for trouble-free air washing service — because there are no internal parts or vanes to wear or clog. Proven through many years of service in water cooling and air conditioning installations totaling more than 5 million g. p. m.

Made in sizes and types for all requirements. Ask for Bulletin N-615.

YARNALL-WARING CO., PHILA.
104 MERMAID AVENUE

NOW! ACCURATE AIR VELOCITY MEASUREMENTS at INTAKE GRILLES!



This new jet attachment can be added to existing Tube-type Velometers now in use, or can be purchased with other standard jets and new Velometers. The new intake grille jet is offered only in the spot type since the center reading only has proven to be sufficiently accurate for all commercial purposes. *Write for information.*

Illinois Testing Laboratories Inc.
143 W. Hubbard St., CHICAGO, ILL.

Three Reasons Why RiP-CLEAN Air Filters Make More Money For You

RIP CLEAN
Renew filters by simply ripping off clogged fibre sheets! It's as easy as that . . . with the RiP-CLEAN Air Filter!
RESEARCH PRODUCTS CORP.
RP
MADISON, WIS.
REG. U. S. PAT. OFF.

1. Longer Mark-Up. Research Filters pay you added profits.

2. Exclusive Selling Features. No other filter has RiP-CLEAN Construction.

3. Complete Sales Helps. Planned to help you sell repairs, as well as filters.

Standardize on the Research RiP-CLEAN Air Filter! You make more money with it . . . conserve valuable war materials. For RiP-CLEAN Filter pads contain critical war materials. The wire grids are used over and over, conserving valuable materials for Uncle Sam.

It's easy to renew RiP-CLEAN filters. Just rip off top layers. No cumbersome cleaning with steam or hot water. No vacuum cleaner or brush needed. No expensive frames to salvage. Write for full RiP-CLEAN details.

RESEARCH AIR FILTERS

RESEARCH PRODUCTS CORP.,
MADISON, WIS.

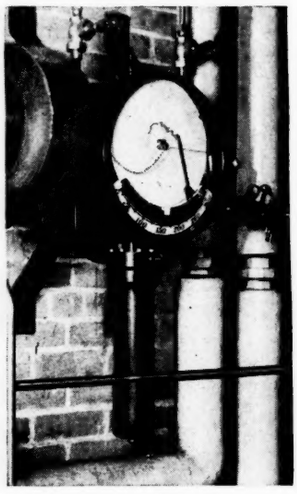
KEEP ACCURATE COSTS

for STEAM, WATER COMPRESSED AIR or GAS

Get the data you need for allocating costs from these direct-reading, evenly-divided charts—recorded with exceptional accuracy at all rates of flow and TOTALIZED on the ADSCO Flow Meter.

Despite its high sensitivity to fluctuation in flow, the ADSCO Flow Meter is so simple and rugged that it cannot be damaged by sudden overloads or reverse flows—is easy to install and maintain.

Available with (1) recording chart, (2) indicating scale and (3) integrator counter to totalize the flow or other combinations thereof. Write us regarding your metering problems—also ask for Bulletin 35-83V.



AMERICAN DISTRICT STEAM COMPANY NORTH TONAWANDA N. Y.

Making "UP-TO-DATE" Steam Line Equipment For Over 60 Years

LET ADSCO FLOW METER TELL YOU HOW MUCH . . . WHEN . . . WHERE

PERSONALS & PERSONNEL

Research Products Corp., Madison, Wis., has appointed the following representatives: *Samuel E. Shea*, 525 Ellicott Square, Buffalo, N. Y., to cover Western New York; *Edward J. Allard*, Swampscott, Mass., to cover Maine, New Hampshire, Massachusetts, and Rhode Island; *Robert L. Marks*, 1228 College, Topeka, Kansas, to cover Nebraska, Kansas, and Oklahoma; and *J. H. Valentine*, 52 East 4th St., South, Salt Lake City, Utah, to cover Utah, and Eastern Nevada.

Bailey Meter Co., Cleveland, Ohio, reports that increased demands for metering and control equipment to speed production in war industries has necessitated an enlargement of its field engineering staff. The following engineers have been assigned to field duty: *J. T. Elder* and *J. E. Wood* to Atlanta, *J. E. Luppold* to Seattle, *E. P. Nye* to Buffalo, *R. B. Pogue* to Milwaukee, *W. D. Hilborn* to Houston, *J. J. Haslam* to Kansas City, *J. J. Wilber* to Cleveland, *C. E. Hicks* to New York, *J. R. Powell* to Pittsburgh, *S. G. Dukelow* to Denver, *R. V. Johnson* to Chicago, *W. D. Robinson* to Boston, and *C. C. Holtzman* to Philadelphia.

Elmer J. Weis

The accompanying photograph is of *Elmer J. Weis*, new vice-president of *Pacific Pump Works*, whose promotion was mentioned on these pages last month. However, due to an unfortunate error, last month's photograph, identified as that of Elmer J. Weis, was actually that of *L. L. Cunningham*, General Controls Co.

Westinghouse Electric and Mfg. Co., East Pittsburgh, Pa., has appointed *B. W. Clark*, formerly vice-president in charge of the merchandising division, as vice-president in charge of sales of the company. He succeeds Ralph Kelly, who resigned to become executive vice-president of the Baldwin Locomotive Works. Mr. Clark, in addition to supervising the sale of apparatus, will be responsible for coordinating all sales of the Westinghouse Company and its subsidiaries. He will transfer his headquarters from Mansfield, Ohio, to Pittsburgh.

French E. Dennison, in charge of the Small Commercial Refrigeration Development Department, York Ice Machinery Corp., York, Pa., has been called by the War Department to serve as chief inspector for the Philadelphia Ordnance District. During World War I, Mr. Dennison served with the Ordnance Department at Rock Island Arsenal and engineered the general refrigeration, water cooling and air conditioning systems at Rock Island. For many years he was chief engineer of the General Refrigeration Company, Beloit, Wis.

Cochrane Corp., Philadelphia, Pa., has appointed *Power Specialty Company*, Houston, Tex., as its representative in southeastern Texas for sale, installation, and service of Cochrane meters. *V. L. Sanderson*, Philadelphia, and his associate, *William Bradford*, Wilmington, Delaware, have been appointed sales representatives in eastern Pennsylvania, southern New Jersey, Delaware, and Maryland for the Cochrane-Becker high-pressure condensate return system.

Allis-Chalmers Mfg. Co., Milwaukee, announces that *Edwin H. Brown* has been elected vice-president in charge of engineering and development. Before assuming the new post, in which he will correlate all engineering activities and the development of new products, Mr. Brown was manager and chief engineer of the engine and condenser department for seven years.

Dorex Division, W. B. Connor Engineering Corp., New York, announces that *Clifford R. Hutcheon,* formerly with the Anemostat Corp. of America, and more recently vice-president and chief engineer of Plandaire, Inc., of Pittsburgh, has joined its engineering staff.

Minneapolis-Honeywell Regulator Co., announces that *Charles L. Saunders,* resident vice-president in charge of the Chicago district, has resigned to assume new duties as chief, instrument section, general industrial equipment branch, War Production Board, Washington.

WITH THE MANUFACTURERS

Young Radiator Co., Racine, Wis., in answer to the March 2 radio appeal of Donald Nelson, WPB chairman, for greatly increased production of war materials, announced the appointment of a company War Production Coordinating Board to be headed by *L. C. Pfost,* plant superintendent, and *Blendon DeMint,* president of Young Local No. 37 CIO, UAW. Two additional Board members will be selected — one from the ranks of the plant workers, the other from the office force. The functions of the Board will be to study production incentive plans in operation elsewhere, to institute a program to acquaint all employees with the company's war production goals, and to cooperate with military and government officials responsible for speeding up the nation's production output. The company is now devoting more than 96% of its total productive capacity to high priority orders for heat transfer units for military and essential industrial needs.

Regan Heating Unit Sales, Division of Marketing, Inc., 828 North Broadway, Milwaukee, Wis., has taken over the national distribution and expansion program for Regan electric heating units.

The Allen-Bradley Co., Milwaukee, has moved its Chicago office to 624-630 W. Adams St. *John McC. Price* continues in charge as district manager.

NEW TRADE LITERATURE

Copies of catalogs and bulletins reviewed in this section are generally available without charge, unless otherwise mentioned. Address request direct to the manufacturer on your business letterhead.

Electric Heating Units. A 38-page standard size catalog, 28-000, including seven pages of application data and selection information, and covering the company's line of electric heating units and controls for industrial applications involving the heating of liquids, solids or air. Department 7-N-20, Westinghouse Electric and Manufacturing Company, East Pittsburgh, Pa.

Refractories. A 4-page standard size folder entitled Greencote Refractory Maintenance Coating for Reconditioning Furnace Linings. A. P. Green Fire Brick Co., Mexico, Mo.

Announcing Great . . Good NEWS *to* Refrigeration Users . . . New A-P

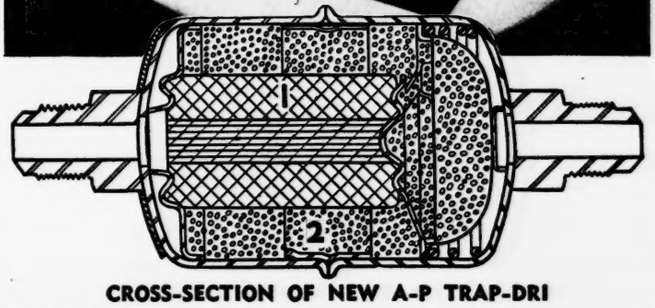
TRAP-DRI { A SINGLE Unit that STOPS ALL IMPURITIES!

Moisture, Scale, Dirt, Solder and Gummy Deposits

Combining the well-known A-P "Trap-IT" element, PLUS SILICA GEL, the new A-P "TRAP-DRI" is the ONLY unit on the market that actually dries, strains and filters the refrigerant, performing THREE important jobs at once! The "Trap-IT" Unit positively prevents foreign particles from entering the system. The Silica Gel removes acids, moisture and corrosive compounds by quick absorption.

EFFICIENT "SYSTEM-PROTECTOR"

TRAP-DRI provides 100% protection for your system. Permits smooth valve operation, prevents freeze-ups.



CROSS-SECTION OF NEW A-P TRAP-DRI

1. "Trap-It" Element consisting of honeycomb filter tube equal to 900-mesh strainer.

2. Silica Gel unit, the most efficient of all drying agents.

NO PRESSURE DROP . . .

There is no noticeable pressure drop in the "Trap-Dri"—an important advantage in any system.

Make YOUR Refrigeration Systems more Efficient and Dependable with the new A-P "TRAP-DRI." Carried in stock by best Jobbers everywhere.

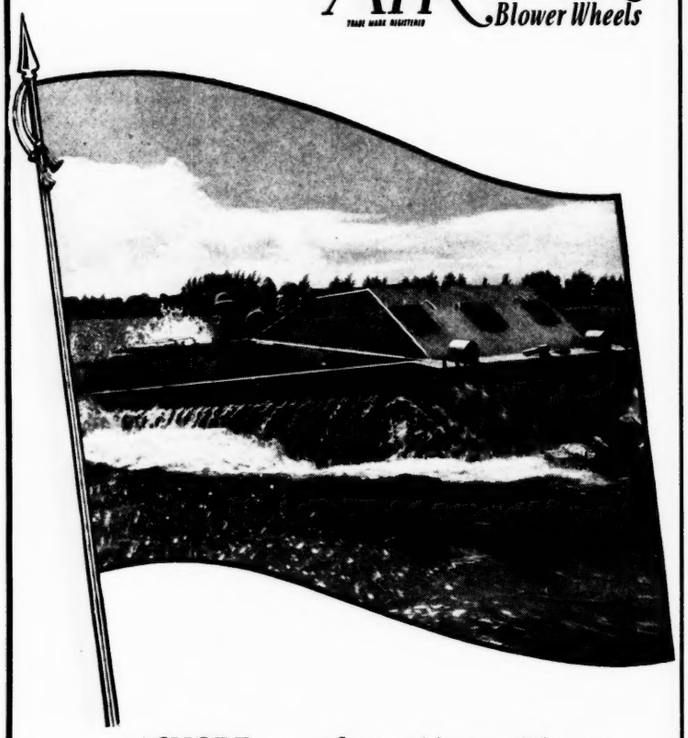
Refrigeration Service Engineers! Your work is IMPORTANT to National Defense NOW! Let A-P Dependable Valves help you keep Refrigeration at peak efficiency.

AUTOMATIC PRODUCTS COMPANY
2462 NORTH THIRTY — SECOND STREET
MILWAUKEE WISCONSIN
Export Dept. 100 Varick St., New York City

DEPENDABLE Refrigerant Valves

AIR for the United States ARMED FORCES

from AIROTOR Blower Wheels



ASHORE or afloat, Airotor Blower wheels perform many functions in equipment of the U. S. Armed Forces.

In one important piece of equipment Airotor Blower Wheels are on land or at sea according to the driver's will. This is in the Marine Corps' amphibian tractor or "alligator tank," where Airotors are used for ventilation of the engine compartment.

More and more Airotors are being applied to equipment which is vital to the war effort. Our research and engineering departments are giving valuable aid by assisting engineers to choose the correct Airotor for each application for today's needs of the fighting forces and for tomorrow's needs for peace.

May we help you?

TORRINGTON

MANUFACTURING CO., TORRINGTON, CONN.

Insulation. A 5⅝ x 7¼ in. 176-page handbook on heat insulation covering the company's line of insulation products and including a comprehensive insulation recommendation section illustrated with 91 drawings and photographs of application details. A useful data section contains 24 pages of engineering tables, graphs and definitions of technical terms. ERHET MAGNESIA MANUFACTURING COMPANY, INC., VALLEY FORGE, PA.

Motors. A pocket size slide rule selector SA-714 for electricians, plant maintenance men and others interested in the selection of electric drive equipment. To guide in the selection of the proper type of motor for each of 44 industrial applications, a convenient table lists the various uses and indicates which of the four principal types of a-c motors should be selected. The specifications, performance ratings and control classes for the required type is readily determined by making the corresponding setting on the slide. Information is obtained from the selector by setting the cardboard slide for the proper motor type and then reading its specifications through the window in the acetate envelope. Obtainable from district offices and distributors. WESTINGHOUSE ELECTRIC & MFG. CO., EAST PITTSBURGH, PA.

Rubber. Four of a series of six pamphlets on How to Get the Most Service Out of Industrial Rubber Products. Intended to assist in the program of rubber conservation made necessary by war developments. Titles of the four pamphlets published to date are No. 1, Transmission Belting; No. 2, Conveyor Belting; No. 3, V-Belt Drives; and No. 4, Belt Salvage. Each pamphlet is sub-divided into chapters written in non-technical language. Available singly or in quantities for distribution to shop foremen or maintenance men. THE B. F. GOODRICH CO., AKRON, OHIO.

Boiler Linings. A practical new bulletin, "The Better Method of Setting and Lining Return Tubular Boilers," 16 pages, standard size, with numerous illustrations and engineering drawings. Explains improvements in methods of setting and relining boilers as well as a discussion of the engineering properties of the company's plastic refractories. RAMTITE CO., 2535 W. 18TH STREET, CHICAGO, ILL.

Acid-Proof Pipe. Bulletin No. 50, a 12-page standard size publication in color entitled "Acid-Proof Pipe and Fittings." A comprehensive and attractive booklet giving dimensional information on each of the company's acid-proof pipe and fittings; data and descriptions on rectangular vent pipe; ventilating caps and damper pipe and similar specialties, together with information on construction, supporting, cutting, accuracy and properties of the company's product. THE U. S. STONEWARE CO., AKRON, OHIO.

Controls. A 48-page, standard size catalog No. 51 of the company's line of regulators, control systems, and solenoid valves. New products included are small commercial size motor operated valves, 3-way magnetic lever valves, sensitive d. c. relays, and the new type PV series electric magnetic valves. Profusely illustrated with photographs, reproduced blueprints, and cross sectional drawings; includes tabulated specifications and list prices. GENERAL CONTROLS CO., 801 ALLEN AVE., GLENDALE, CALIF.

Patents. A very attractive 54-page standard size booklet on Patent Background for Engineers prepared by six authorities on the subject. ALLIS-CHALMERS MFG. CO., MILWAUKEE, WIS.

Wrought Iron. A standard size, 62-page, 1942 general catalog giving complete information on the company's products, including an index of technical publications available from the company, descriptions, specifications and standards on wrought iron and steel, dimensional, weight and other data on the company's pipe, casing, tubing, plates and sheets. The company announces that while it is heavily engaged in war work, nevertheless it is able to supply co-defense workers who have government approval. A. M. Byers Company, Pittsburgh, Pa.

Boilers. Catalog No. 42 describing the company's line of magazine feed heaters with capacities from 175 to 3500 sq ft of steam radiation and equivalent. Bulletin is standard size, eight pages; features are summarized on second and eighth pages and remaining pages are devoted to photograph, dimensional drawings, capacity and other data. Spencer Heater Division, The Aviation Corporation, Williamsport, Pa.

WHAT READERS SAY

Windowless Newspaper Plants

Editor, Heating and Ventilating:

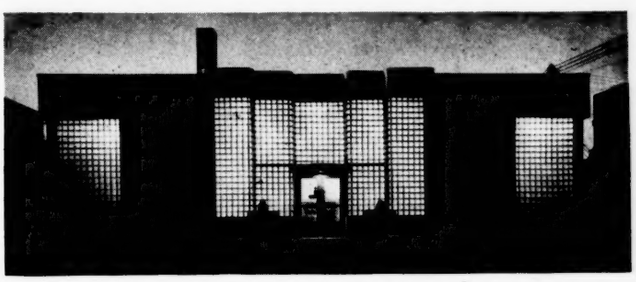
The Rust Engineering Company, Pittsburgh, Pa., . . . calls our attention to an article in your February issue on the *Painesville Telegraph,* which they feel conveys a misimpression.

The statement in your article heading, namely: "Air Conditions Its Windowless Plant—The First Newspaper Building of This Kind" is not exact; and the same applies to the statement in the body of the article that the *Painesville Telegraph,* as a completely conditioned windowless building, "has blazed a trail in this respect."

The Rust Engineering Company designed and constructed a newspaper building similar in size and general details to the *Painesville Telegraph* previous to the construction of the latter building.

This building was constructed by The Rust Engineering Company for The Republican Publishing Company, Mount Vernon, Ohio, publishers of the *News.* Construction was begun in the fall of 1938; and the building was opened April 3, 1939. It is completely windowless, glass-block-walled from floor to ceiling, and completely air-conditioned.

The *Painesville Telegraph* itself was begun in September, 1939, and completed about a year after the *News.* Mr. C. A. Rowley, owner of the *Painesville Telegraph,* who had learned from the proprietor of the *News* how well the mechanical features of that building were working, called in The Rust Engineer-



Windowless, glass-block-walled, and completely air conditioned plant of the Mount Vernon "News" opened April, 1939.

HE DREW THE PLANS FOR FLEETWINGS' FANS

CHARLES H. KNECHT (*left*), head of the Harry Knecht Co., Merchantville, New Jersey, specified ILG Power Roof Ventilators . . . when his firm of heating and ventilating contractors recently handled a heat-and-fumes-removal problem in a plant turning out Fleetwings, basic training planes for army air bases.

FIRST STAINLESS STEEL PLANES for military use are the BT-12's being built in this modern plant (*below*)... Heat, smoke, welding fumes are removed by six 42-in. ILG Self-Cooled Motor Propeller Fans in the penthouses.

ILG "SELF-COOLED" MOTORS stand continuous operation under direct radiant heat of sun . . . and terrific heat from working zone!... In addition to ILG units pictured above, the plant is served by six 30-in. ILG Propeller Fans on a smaller building . . . and ILG B-18 Blowers supply fresh air to inside test rooms.

FREE CATALOG
Ask for No. 141

POSITIVE ALL-WEATHER VENTILATION—Powerful ILG Self-Cooled Motor Propeller Fan in weather-tight penthouse assures quick, positive ventilation under all weather conditions. Exclusive self-cooled motor that "breathes"—never over-heats, is not affected by moisture condensation, lowers costs.

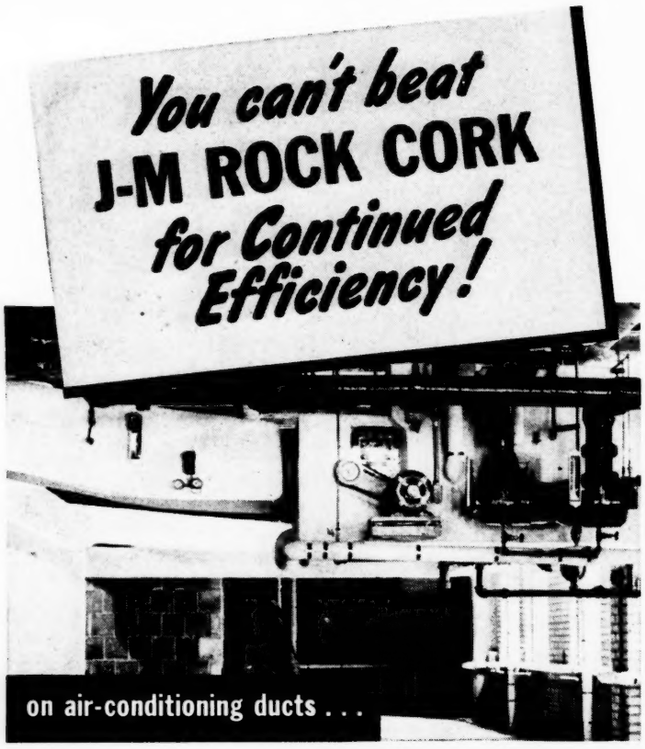
ILG ELECTRIC VENTILATING CO., 2858 N. CRAWFORD AVE., CHICAGO, ILL.
OFFICES IN 41 PRINCIPAL CITIES CONSULT YOUR PHONE DIRECTORY

ILG

Vitalized Ventilation

AND AIR CONDITIONING

AIR CHANGE . . . NOT JUST AIR MOVEMENT!



THAT'S NOT JUST A CLAIM. It's a statement of fact based on more than 25 years of outstanding performance on scores of jobs.

The explanation . . .

Rock Cork is basically mineral. This means complete freedom from rot and decay . . . strict sanitation . . . no trouble with vermin . . . the end of moisture and mold problems!

You'll find, too, that installation is economical, for Rock Cork is easily, quickly applied. And year after year, it retains its high efficiency—maintenance costs are practically zero. For details, write for brochure DS-555. Johns-Manville, 22 East 40th Street, New York, N. Y.

Johns-Manville
ROCK CORK
Low-Temperature Insulation
In Sheet Form and for Pipe Covering

ing Company for consultation in September, 1940, about six months after the *Painesville Telegraph* plant went into operation.

The occasion was the inability of the air conditioning system to cool the building adequately in certain sections, and the building up of pressure in certain sections. The Rust Engineering Company's report to Mr. Rowley, dated October 17, 1940, recommended use of a compressor and other measures described in the article which have apparently successfully overcome the difficulties.

Edward W. Goss

SCHOYER & GOSS,
PITTSBURGH, PA.

Yearly Fuel Consumption

EDITOR, HEATING AND VENTILATING:

Referring to your article setting up a formula on the method of figuring coal consumption and coal storage bins ("Practical Data for Solving Wartime Fuel Storage Problems," H & V, March, 1942), perhaps your readers would be interested in our fuel consumption chart of which we have a supply available. This chart, printed on 8½ x 11 in. loose-leaf punched sheets, gives a quick answer to the question of yearly fuel consumption per 100 sq ft of steam or hot water radiation or per 24,000 Btu heat loss for warm air, when the heating value of the anthracite, coal, oil or gas is known together with the number of degree days and the overall boiler efficiency.

M. R. Grover,
Assistant to the President.

ANTHRACITE INDUSTRIES, INC.,
NEW YORK, N. Y.

COMING EVENTS

APRIL 9-10. Midwest Power Conference, sponsored by the Illinois Institute of Technology, with the cooperation of nine mid-west universities and seven mid-western engineering organizations. Headquarters, Palmer House, Chicago, Ill. Further information available from C. A. Nash, Conference Secretary, Illinois Institute of Technology, 3300 Federal St., Chicago.

APRIL 13-17. Twenty-seventh annual meeting of the American Association of Industrial Physicians and Surgeons and the third annual meeting of the American Industrial Hygiene Association. Hotel Gibson, Cincinnati, Ohio. The third day will be devoted to a symposium on lead poisoning. For further information address the Industrial Hygiene Foundation of America, Inc., 4400 Fifth Ave., Pittsburgh, Pa.

MAY 24-29. 53rd annual meeting of the Heating, Piping and Air Conditioning Contractors National Association, Hotel Schroeder, Milwaukee, Wis.

MAY 26-27. 24th annual meeting of the Stoker Manufacturers Association, Green Briar Hotel, White Sulphur Springs, W. Va.

JUNE 10-12. 33rd annual meeting of the National District Heating Association, Dayton-Biltmore Hotel, Dayton, Ohio. Further information from John F. Collins, Jr., secretary, NDHA, 827 N. Euclid Ave., Pittsburgh, Pa.

JUNE 15-17. Semi-annual meeting, American Society of Heating and Ventilating Engineers, Hotel St. Paul, St. Paul, Minn.

H&V'S PHOTOS

Page 28—(upper right) OEM Photo.

THERM-O-TILE

10 Outstanding Advantages of This ONLY TRULY COMPLETE Underground Pipe Conduit

1–Less excavation required.
2–Installation can be started at once. Tile not required until after pipe is installed and tested.
3–Pipe supported on concrete foundation which holds grade permanently. No condensate pockets.
4–Pipe installed without interference of tile or other trades working at same time.
5–Internal drain allows no accumulation of water.
6–Internal drains connected through manholes — not outside of manholes. Permits periodical inspection.
7–Arch construction carries greater loads than other shapes.
8–No bell joints, hence easily waterproofed with membrane waterproofing.
9–Steam lines easily repaired at any time.
10–Greater thermal efficiency. Surrounded by air rather than by damp earth.

In addition Therm-O-Tile is durable; permits expansion and contraction; cave-ins and inclement weather cause less damage and expense. Etc.

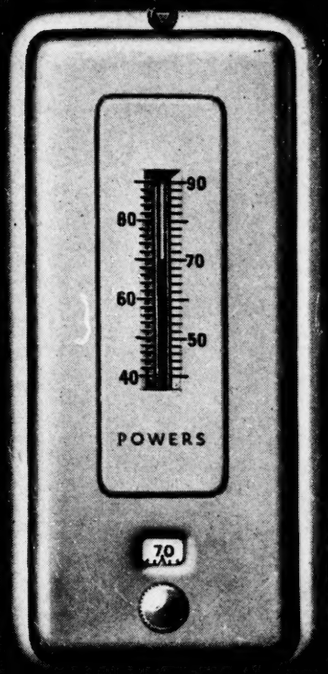
Ask for Bulletin 381.

Sold and installed by Johns-Manville Construction Units in all Principal Cities. See our page in Sweet's or The Heating Guide.

H. W. PORTER & CO., Inc.

823-V Frelinghuysen Ave., Newark, New Jersey

GRADUAL CONTROL



has been an outstanding feature of Powers regulation since 1891. With this type of control, valves or dampers are opened or closed **gradually**, which results in exceedingly close regulation and the maximum of comfort obtainable with automatic control.

● THE POWERS REGULATOR CO., 2718 Greenview Ave., Chicago—231 E. 46th St., New York. Offices in 47 Cities. 43

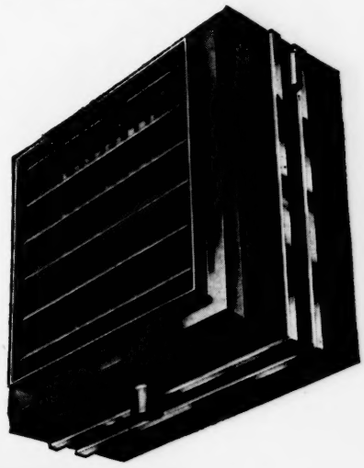
WRITE FOR BULLETIN NO. 200

POWERS TEMPERATURE *and* HUMIDITY CONTROL

WE CAN DELIVER

within a reasonably short time

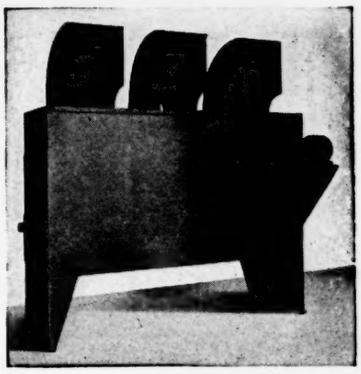
Our unit heaters are equipped with ALL STEEL Heating Elements. We have always standardized on ALL STEEL Elements, and therefore do not need to change our methods in spite of the war. Many years of experience and research are built into every model. Hundreds of American factories are efficiently heated by Airtherm Unit Heaters.



The AIRVECTOR

Propellor Fan Type Unit Heater

For floor and ceiling mounting, makes a highly efficient installation. Rugged construction. All-welded joints. Available in a complete range of sizes for any job. Quiet and efficient operation. Good heat distribution over large area.



The AIRHEATOR

Centrifugal Fan Type Unit Heater

With many exclusive features in design and construction. Great resistance to corrosion, pressure and temperature. Airvector Unit Heaters have Ribbed Cabinets, greater rigidity, and eliminate vibration and "sounding board" action. Models are mounted with four-point saddle type suspension. Complete range of sizes for any job.

Write today for information.

AIRTHERM

MANUFACTURING COMPANY

722 S. SPRING AVE. ST. LOUIS, MO.

ALPHABETICAL INDEX OF ADVERTISERS

A

Air-Maze Corp. ..... *
Airtherm Mfg. Co. 81
American Air Filter Co., Inc. 14
American District Steam Co. 76
American Rolling Mill Co. ..... *
Armstrong Machine Works ..... *
Automatic Products Co. 77

B

Baldor Electric Co. 73
Barber-Colman Co. 3
Bethlehem Steel Co. 69

C

Carey, Philip, Mfg. Co. 71
Clarage Fan Co. ..... *
Classified Advertising 82
Continental Steel Corp. 5
Curtis Refrigerating Machine Div. of Curtis Mfg. Co. 8

D

Detroit Stamping Co. 73
Dravo Corporation 12
Dunham, C. A., Co. 7

E

Elgo Shutter & Manufacturing Co. *
Enterprise Engine & Foundry Co. *

F

Formica Insulation Co. 15
Fulton Sylphon Co. 11

I

Ilg Electric Ventilating Co. 79
Illinois Engineering Co. ..... *
Illinois Testing Laboratories, Inc.. 75

J

Johns-Manville 80
Johnson, S. T., Co. 73
Johnson Service Co. ..... Back Cover

K

Kewanee Boiler Corporation 10

M

Marsh, Jas. P., Corp. ..... *
McQuay, Inc. .....Inside Back Cover
Minneapolis-Honeywell Regulator Co. 9

N

Nash Engineering Co. 18
Niagara Blower Co. 71

O

Owens-Corning Fiberglas Corp. ... 67

P

Porter, H. W., & Co., Inc. 81
Powers Regulator Co. 81

R

Research Products Corp. 75
Ric-wiL Co. 6

S

Sarco Company, Inc. 75
Schaible Foundry & Brass Works Co. ..... *
Smith, H. B., Co., Inc. ..... *
Somers, H. J., Inc. 82
Staynew Filter Corp. ..... *
Sterling, Inc. ..... *
Surface Combustion Corp. ..... *

T

Taylor Forge & Pipe Works..... 13
Torrington Manufacturing Co. ... 78
Trane Co. 4
Tube-Turns, Inc. 65

W

Wagner Electric Corp. ..... *
Want Advertisements 82
Webster, Warren, & Co. 16
Westinghouse Electric & Mfg. Co., Inside Front Cover

Y

Yarnall-Waring Co. 75-82
Young Radiator Co. ..... *

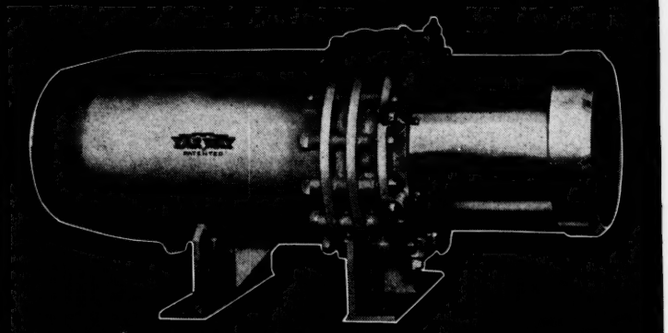
*Advertisement appeared in preceding issue.

YARWAY GUN-PAKT EXPANSION JOINT

It is packed under full steam pressure. By the turn of a wrench, integral pressure guns force a special semi-plastic packing into the stuffing box.

Welded Steel Construction. Alemite lubricated cylinder-guided sleeve. Made also in conventional gland-pakt types. Write for Bulletin EJ-1907.

YARNALL-WARING COMPANY
104 Mermaid Ave. PHILADELPHIA



INDUSTRIAL AIR CONDITIONING
Needs SOMERS HAIR GLASS FILTERS

Somers Filters are built with frames of galvanized metal, packed with Hair Spun Glass — washable — odorless — non-absorptive — non-rotting — and are practically indestructible.

Dust, dirt, pollen, detritus and industrial wastes in the air stream effectively removed with minimum back pressure. No adhesives required.

Made in every size required for industry. In use in a wide range of factory applications, for chemical, textile, and metal-working installations where precision is a factor.

SOMERS HAIR GLASS FILTER "V" type

Quotations supplied on receipt of c.f.m. per unit and dimensions of master holding frames. A few choice territories open for qualified representatives.

H. J. SOMERS, INC., 6067 WABASH AVE. DETROIT, MICH.

CLASSIFIED ADVERTISING

FOR SALE — Sand Blasting Equipment. 2—No. 100 Type I Fans, Clarage Fan Co.; 1—No. 9 Sirocco fan, American Blower Corp.; 2—Dust collector bins, capacity each 13,000 lbs.; 4 hopper bottoms, size 8'x32' x11' high; 1—75 ton storage bin. Bargain for immediate sale. Rupp Equipment Co., 2131 Fillmore Ave., Buffalo, N. Y.

POSITION OPEN for graduate engineer with experience in the design, installation and operation of industrial air conditioning and process air handling (drying, etc.). Chemical background desirable. State age, salary expected, etc. Box No. 554, care HEATING AND VENTILATING, 148 Lafayette St., New York.

HEATING AND VENTILATING

The Air Conditioning Monthly